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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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INDUSTRY PLANNING AND ECONOMICS

EQUIPMENT REPAIR ORGANIZATION OF MACHINE-BUILDING PLANTS

Kiev EKONOMIKA SOVETSKOY UKRAINY in Russian No 10, Oct 85 pp 36-39

[Article by V. Semenikhin, economist: "Equipment Repair Organization of Machinebuilding Plants"]

[Text] The main road to the development of machinebuilding and the intensive reequipment of the sector at the modern stage of scientific technological design is inseparabley tied in with the wide use in production of computers, robots, NC machine tools and the introduction of flexible technology. In this connection there is a great demand for reliable equipment and the organization of its technical-servicing repair.

The existing order of organizing repairs was basically formed in the second half of the thirties. In several following decades it corresponded to the general structure and the production structure of shops and enterprises, and methods for controlling the machinebuilding complex of the country and kept machines and devices fit for work operating during that period. However, the existing repair system, in spite of its positive individual qualities, has serious shortcomings. In this connection, it is very urgent to develop and implement the radical reorganization of equipment repair services stage-by-stage.

At present, repairs of technological, power and materials handling equipment at plants are all done by the services of their chief mechanic (SGM) and the chief power engineer (SGE). Practically, large and most medium sized plants use decentralized control of repair services or a mixed system for repairs. The Kiev "Krasnyy ekskavator" and the Kiev Motorcycle plant are such enterprises.

As a rule, the control of a centralized repair service at small plants is combined with centralized or mixed implementation of repairs. Along with this, several enterprises with up to 1500 units of technological and materials handling equipment, have decentralized or mixed repair services control, although there is no basis for its use. This situation exists by using the services of the chief mechanic and chief power engineer of the Dnepropetrovsk Machine Tool Building Plant and the service of the chief mechanic of the Kiev Experimental Model Reducer Plant.

In the existing organization of repairs in a group of plants we investigated, 68.2 percent of the SGM workers are concentrated in repair shops (building) bases (TsRB) and only 31.8 percent -- in mechanical repair shops (RMTs). Half the metalworking equipment of the repair service is located at the TsRB. Accordingly, shop repair bases meet 40 to 50 percent of the general spare parts requirements in a decentralized manner.

Decentralized control of repair services in combination with a decentralized or mixed implementation of repairs makes possible the following: to establish direct responsibility of machine tool operators and production shop foremen for the technical condition of the operated equipment; to achieve high efficiency in making repairs; reduce to a minimum the costs of transporting machine tools or its individual units to TMRs or TsRB; do without strict accounting for idle time of equipment being repaired and the organization of dispatcher services in the chief mechanic and chief power engineer departments; contradictions in the interests of repair mechanics and electricians who have achieved their realization in the channel of economic interests of the whole shop collective.

Along with that, the shortcomings of concentrating repairs within an enterprise and dividing the functions of their control among many subdivisions are obvious. Thus, in a prevailing majority of machinebuilding plants, the machine tool pool is very inefficient in the RMTs and the TsRB. An analysis shows that the TsRB equipment shift coefficient is $2/3-\frac{1}{2}$ that of the basic shops. It exceeds one very rarely. The intensive use of equipment is also low. This situation is due to the fact that with decentralization the mechanical sections of the shop repair bases must be equipped with all the necessary equipment to implement 75 to 90 percent of the machine tool work specified by capital, medium and small repairs and technical services. As a rule, only universal lathes, gear-hobbing machine tools, grinders and bench drilling machine tools are the most loaded of the entire set of installed equipment. Planing, slotting and grinding machine tools are used only occasionally.

The dependence of repair services on directions of the production shops, in the administrative respect, leads to the diversion of repair workers to work not related to their primary activity. Thus, at the machinebuilding plants we investigated, the basic production of 10 to 20 percent of the workers is con-constantly diverted from the TsRB to basic production, agricultural and other work.

Most work related to repairs and technical servicing of equipment is done manually without the use of machines and devices. The level of mechanization of labor of repair workers is 20 to 25 percent. This low value of the given indicator does not at all follow from the nature of the repair work but, due to a great extent, by the fragmentation of the services of mechanics and power engineers. In repair work, the cleaning and washing equipment, rinsing bearings, pinions and other complementing units can be done in special washing machines and tanks. This makes possible a considerable reduction in the time it takes to do the above operations, but also avoids the workers having contact with unhealthy washing substances and spent lubrication materials.

The nature of the work of assembling and disassembling does not exclude the use of electrical and pneumatic tools for the time being mainly in assembly shops of machinebuilding plants. Devices for repairs of materials handling, and the transportation of machine tools and their individual units, which have already been developed and are being used in leading enterprises of the country, increase the efficiency of repair workers considerably.

Due to the variations in the subordinate lines of production shop repair personnel, the maneuverability of work is lost. In practice, the frequent overloading of the repair workers with urgent work in some shops coincides with their being underloaded in others. Yet temporary shifting of workers from shop to shop is difficult. There are frequent disruptions in the preventive maintenance schedules and low labor productivity due to the impossibility of providing a sufficient specialization level in executing repairs.

The question of the advisability of making the repairs on technological equipment deserves steady attention by using two services, the service of the chief mechanic and the service of the chief power engineer. The existing situation led to the complication of the production structure and the repairs management structure and generated a complication of interrelationships between two collectives of repair workers servicing the same equipment. Thus, working time losses due to disagreement in the work between the personnel of the mechanical and power services in production shops amounts to 5 to 6 percent of the shift time, according to the results of photographs made during a working day. Preventive maintenance schedules are prepared in parallel in SGM and SGE duplicating the record of the equipment which, later, is corrected and tied together at various levels. Enterprises also have difficulty keeping track of costs and allocations of funds for various kinds of repairs. In our opinion, subordination of repair workers to two various services is one of the basic reasons that impede the wide combination of the trades of repair mechanics and electricians.

At present, about 1/5 of all labor-intensive work done by the chief power engineer's service is production wiring, repairing sanitary engineering equipment and ventilation systems. In a group of enterprises investigated in Kiev and Dnepropetrovsk, 40.7 percent of the SGE workers service and repair power equipment, monitoring and measuring devices, and electrical power and gas-supply networks. The number of workers repairing electrical and electronic parts of the technological and materials handling equipment varies in individual plants from 30.8 to 43.9 percent and makes up, on the average, 38 percent of the total number of workers in the chief power engineer's service. According to our calculations this part of the repairmen does over a third of the total work on servicing technological and materials handling equipment. The chief mechanic's service does 63 to 65 percent of the total indicated work.

The labor-intensity of electrical repair work increases with the automation of production. The efficiency of the equipment depends more and more heavily not only on the chief mechanic's service, but also on wiremen and electricians of the service of the chief power engineer.

Based on the results of our investigations we think it advisable to concentrate, in the SGM, the entire personnel involved in repairs and technical servicing of the mechanical as well as the electrical (electronic) part of the technological and materials handling equipment. It is better to rename the chief mechanic's service to the repair-technical equipment service (SRTO). There are premises at present in machinebuilding to create a unified repair service. Thus, in many plants, according to the "Efficient system for technical servicing and repairs of NC machine tools," developed by the ENIMS [Experimental Scientific Research Institute of Metal-Cutting Machine Tools], all the work on repairs of NC machine tools is done by the chief mechanic's service.

Such an organization exists, for example, at the Kiev Machine Tool Building Production Association. All personnel servicing technological and materials handling equipment is administratively subordinate to the shop mechanic in the production shops of the Kiev "Krasnyy ekskavator" Plant, with decentralized fulfillment of repair work. Materials handling at the Kiev Experimental Model Reducer Plant is serviced by brigades made up of repair mechanics and electricians.

The chief power engineer's service, after reorganization, must deal with all kinds of power as well as technical servicing and repairs of power equipment, sanitary engineering equipment and ventilation devices. New prospects open up in developing and implementing measures on the economy of power resources.

The creation of a unified repairs-technical service in an enterprise to service technological and materials handling equipment assumes the combining of a number of repair bases and the building of repair services, or repair services of specialized productions (machine-assembly, forge-press and casting). This opens up possibilities of having specialized brigade complexes consisting of mechanics and electricians to repair single-type equipment. There are mechanical sections in building repair services. Their organization makes it possible to improve the use of equipment, simplifies the problem of combining machine tool operators with a specialized brigade to provide it with tools and intermediate products, reduce labor-intensity and raise the quality of repair parts. I want to stress the fact that the KRS [Building Repair Service] pool equipment is 30 to 40 percent smaller than the pool of machine tools of the previously independent shop repair bases of the building.

When the territorial disposition of individual shops or the specifics of the equipment installed does not permit the organization of repairs within the framework of the KRS, then shop services for comprehensive repair servicing are created. In our opinion, it is advisable that all repair services (shop as well as building) be subordinate to the SRTO chief of the enterprise. The subordination of TsRS and KRS to the repair shop is justified only at small plants.

In reorganizing repair services, there is the necessity of creating a section within the RMTs to repair the electrical parts of machine tools and machines. Capital repairs of generators and motors related to rewinding windings, are done at specialized "Glavelektroremont" All Union Production Association plants or are transferred to the electrical repair shop of the chief power engineer's service.

Plants operating NC equipment create a laboratory for repairing it within the SRTO. This subdivision also services automatic manipulators and later will service flexible production modules and complexes.

The approach to introducing and servicing flexible modules at the Kishinev Color TV Plant merits attention. A flexible automatic production department (GAP) was created at the plant. It includes the former mechanization and automation of production processes department and a shop for manufacturing special technological equipment and the means of mechanization as well as a section of robots, manipulators and an entire complex of GAP equipment for adjusting and startups in production. Thus, a single service combines GAP specialists, developers, workers and engineers occupied in installing, adjusting and repair-technical servicing of equipment for flexible production. In the course of creating an automatic section to assemble and install printed circuits, a comprehensive brigade consisting of engineers (mechanics, electronics, programer, technologist) and workers (adjusters, operators, fitters) was formed in the GAP department. The brigade does the following work: it installs and adjusts the equipment, starts up the equipment and tests it in the operating mode, trains personnel at work positions to service the complex to achieve the rated productivity, and transfers the module to the assembly shop. At the last stage the brigade was divided into two parts: in one part (with additional people) its previous functions were preserved, while the other part was transferred to the assembly shop to service the equipment. The system for organizing and stimulating the GAP service workers at the plant made it possible to reach the rated capacity in a short time and to achieve high technical-economic indicators in the operation of the automatic section. The comprehensive approach of the plant collective to the introduction of flexible production can also be utilized successfully at machinebuilding plants taking into account the special features of the sector.

The bases of the GAP repair servicing must already be laid in the process of the design, production and location of flexible productions. In our opinion, in the course of design development and production of the GAP it is advisable to foresee higher reliability and suitability for repairs of highly complicated equipment which does not have doubler equipment. The modular principle in designing GAP equipment makes it possible to introduce a unit repair method in the process of its operation which simplifies preventive maintenance and monitoring work, and creates conditions for developing and introducing diagnostic means. Along with this it facilitates a reduction in the "development-manufacturing-introduction" cycle and reduces the cost of design and manufacture of the equipment considerably.

The efficiency of the servicing of repairs of flexible complexes determines greatly the nature of their disposition at plants within a region. It is advisable to determine at which of the various industrial sectors it is most important to locate the base plants and factories selected, as a rule, from the number being built or that are to be modernized with comprehensive introduction of automation. Concentrating GAP within one industrial center is very important because this would make it possible to create interbranch cost accounting firms for the exchange and restoration of standard electronic units and typical mechanical modules. Under such conditions, enterprises will be

able to have only a limited list of spare repair parts and units. The problem of servicing flexible complexes and repairing GAP units by out-of-town brigades of specialized repair enterprises and equipment manufacturing plants will become less acute. This is especially important to small- and medium-sized enterprises where the shortage of skilled personnel for the repair of NC machine tools equipped with automatic manipulators is already being sharply felt.

In our opinion, it is most advisable to have a time-rate plus bonus wage system with established norm tasks for workers who service flexible modules and complexes. The use of hourly wage rates approved for piecework workers who work on machine tools under normal labor conditions with additional pay for high trade skills produces a positive result.

A changeover to comprehensive technical servicing and repairs of technological equipment and centralized control of the chief mechanic's service are imcompatible with the fulfillment functions not natural to it. Here the ratio of workers in the production of only nonstandard equipment and who work in repair-construction work make up 13.5 percent, on the average, of the total number of repair workers in the chief mechanic's service in a group of enterprises we investigated, including 42.4 percent at the Kiev Experimental Model Reducer Plant.

Installation work and the manufacture of nonstandard equipment are similar to equipment repairs. However, imposing them on a unified repairs service which depends upon specific conditions would be correct only for small and individual medium sized plants. On the whole, we consider it advisable to create independent sections of nonstandard equipment, or to include them in shops for the production mechanization means and subordinate them to the department of mechanization and automation of production processes.

A changeover to a centralized form of control in combination with a centralized or mixed system for doing repair work in the SRTO makes it possible to: provide an administrative-economic independent unified repair service, and introduce cost accounting in all its links; reduce considerably or fully eliminate the doing of nonrepair work by RMTs and TsRB of plants; raise the level of labor mechanization of repair workers and improve the technology of repairs; develop the brigade form of organization and wages on a qualitatively new basis; create repair-ASU; reduce or stabilize the number of repair personnel. The new organization of the repair service -- is a necessary condition for the efficient servicing of automatic lines, NC machine tools and robot equipment complexes.

The idea of transferring all functions for repair and technical servicing of equipment to the service of the chief mechanic at medium and large plants is not new, although up to the present it was not used widely in practice. Here one of the first steps in the direction of the detailed development of the unified repair service concept and its wide practical realization are the recommendations of the ENIMS (1982) on organizing repair work at machinebuilding plants.

The reorganization of production repairs imposes new higher demands on repair personnel and requires considerable psychological changes in workers under new conditions. With the development of the collective form of repair workers, the labor requirements of a wide profile of workers and training them in a second trade increases. Timely retraining and raising the skills of engineers and technicians (mainly in mechanical and power shops) is an important problem. It is already necessary to train VUZ electrical engineers in comprehensive servicing of technological equipment of machinebuilding enterprises as specialists in GAP repairs.

It is necessary to review the existing material incentive system for repair personnel. In the machinebuilding plants that we investigated the wages of repair workers are 17 percent less on the average than the wages of basic workers. At the same time, the average rate class of repair workers is higher by one. Such a differentiation in wages of the considered worker categories can be acknowledged to be correct neither from the theoretical nor from the practical viewpoints. It is the result of the false understanding of the role the repair personnel play in servicing and increasing the efficiency of modern automatic production, and an attitude which regards repair servicing as secondary.

The functioning of a unified repair service must be taken into account in developing plans for the modernization and construction of industrial enterprises.

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INDUSTRY PLANNING AND ECONOMICS

EXPERIENCE, GOALS OF LATVIAN HYDRAULIC CYLINDER PLANT

Riga NAUKA I TEKHNIKA in Russian No 2, Feb 86 pp 9-10

[Interview by A. Tertse under the "Toward the 27th Congress of the CPSU" rubric: "'Liyepayselmash' in the 12th Five Year Period"]

[Text] In late October of the past year a government commission received the last stage of a new hydraulic cylinder production process at the Liyepaya Farm Machine Factory with an appraisal of "excellent", as well as a galvanization and a blank production shop.

The director of the plant, I. Chirkshis, comments on these facts:

Chirkshis: Our plant is one of the leading enterprises of Soviet Latvia, whose reconstruction and also expansion have been included in the USSR Food Program, and a maximum integrated mechanization of agricultural production is envisioned. All modern farm machinery must have hydraulic cylinders. The need has therefore arisen for a substantial increase in production of these articles. According to plan, the factory should produce 1.1 million hydraulic cylinders of various sizes per annum. However, only in 1988 is the full designed capacity to be reached. But the enterprises receiving our products cannot wait that long. Therefore, we resolved to place a new shop in operation by separate stages. In 1983 construction was completed on the production building, enabling us to create the plant for the ever increasing scheduled production of hydraulic cylinders. We also derive advantages from the gradual expansion of the enterprise: it takes less effort to assimilate the new machinery and technology in the first production lines, so that the succeeding lines can be brought into operation at full capacity more quickly.

Question: Cooperation between the factory specialists and the construction workers has enabled an economization of two months and a completion of all work in the new shops ahead of schedule. Does this mean that they will also begin operation at full capacity sooner?

Chirkshis: Of course! As of 1 January 1986 we are operating on a new budgetary principle, which was basically validated in an economic trial in the preceding year. The new budgetary mechanism allows us to determine ourselves the development prospects and time frame. The better our progress, the more resources we will be able to devote to modernization of production and

enhancement of the working and living conditions of the workers. Thus, we are interested in beginning operation at maximum capacity as soon as possible. I believe this will be possible as early as July.

Question: After the redesign in the shops much modern technology has appeared. There is also no shortage of young workers at the factory.

Chirkshis: Yes, more than 10 percent of the industrial robots at the disposal of the republic are functioning at our enterprise. This, naturally, attracts young workers, engineers and technicians. Many of the workers of the hydraulic cylinder shop began their career at Moscow factories, where they took part in the assembly of automatic production lines. Next they installed these lines at Liyepaya and are servicing them themselves. Our specialists are highly trained.

Question: What is your "park" of new technology?

Chirkshis: An automatic line has been built for machining of hydraulic cylinders. Industrial robots (most of which have been produced by the People's Republic of Bulgaria) move the workpieces about, feed them for machining, and extract them. There are also 14 mechanized welding flow lines and 6 automated galvanization lines at the factory. Furthermore, the new hydraulic cylinder production process has more than 110 metal-cutting and machining lathes and various other machinery. Its introduction has enabled a 35 percent increase in labor productivity, improved product quality (80 percent of the products have been awarded the Government Seal of Quality), a more economical outlay of metal, and a lower labor intensity of the processes. It is for these reasons that we currently produce the least expensive hydraulic cylinders in the nation.

Question: During the installation of the equipment the engineers, technicians and factory experts have upgraded it and found new solutions...

Chirkshis: The recently adopted resolutions of the party and state require science and industry to go hand in hand. The draft of the Basic Lines of Economic and Social Development of the Nation underscores the fact that no less than two-thirds of the gain in productivity of social labor in the [next] five years should be due to advances in science and technology. We have called upon the scientists for help from the very outset of the redesign. The experts of the research institutes and design bureaus of Voronezh, Rostov-on-Don and other cities have helped design, build, and introduce, for example, cold plastic metal deformation machines, gages for the accuracy of machining of the surface of cylinder housings, and an automatic complex for cold pipe rolling. In future, this equipment will allow the factory to convert to a no-waste technology.

High-performance cutting tools with hard alloy and ceramet blades are still being produced in insufficient amounts, and therefore we utilize our cutting tools for as long as possible. And in order to prevent breakage in the robotic production lines, it is necessary to determine the degree of wear

on the cutting tools without stopping the machine. The experts of the Riga Polytechnical Institute imeni Pelshe are developing a diagnostic system to determine the condition of a cutter, for example, on the principle of a vibroacoustical signal, informing the operator which tool to sharpen and adjust, and which to replace. I could mention other similar examples of cooperation.

Question: A technology office for introduction and operation of new machinery has been organized in the hydraulic cylinder shop. What is the reason behind this?

Chirkshis: First, this will help assimilate new equipment and technology. Second, in the near future we must bring the working pressure of the hydraulic cylinders from 100 up to 160 atmospheres. We shall be striving to improve the quality of the products at the same time as raising the labor productivity and saving on rolled metal. Thirdly, the improvement of farm machinery entails a conversion to telescopic hydraulic cylinders. This means that the industry should be reoriented toward production of such product by the end of the five year period.

In order to keep pace with scientific and technical progress in industry, it is also necessary to teach the workers. We have already begun organizing a factory professional technical school. Its 720 pupils will be learning skills of attendance of modern machinery in production training rooms outfitted with the same machinery as the plant production.

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INDUSTRY PLANNING AND ECONOMICS

FLAWED ORDERING OF EQUIPMENT DESCRIBED

Tbilisi MOLODEZH GRUZII in Russian 25 Mar 86 p 2

[Article by A. Glurdzhidze and A. Yeremyan, under the rubric: "There are Millions in Our Pockets"; "Omelet on the Thermal Stove, or Some Opinions on Alleged Machine Tools"]

[Text] An agitated colleague shared his misfortune: he had left his writing pad on the bus. Therefore, for a long time he painfully tried to recall: "I think it is in the nineteenth shop, or maybe in the machine tool building shop. The uninstalled equipment is likely there."

"Yes, we have such equipment," we were told in shop 19 of the head plant of the "Stankostroitel" Production Association. "There they stand -- four machine tools. Expensive, with eight spindles, nobody needs them."

Why then do the red-yellow giants stand modestly in the corner of the shop?

Opinion One

"They will not start operating very soon," so they think in the 19th pinion shop. "It is not that there were technological complications, -- there is nobody to work on them."

"Why?" we asked, surpised.

"Because it is not profitable," was a friendly reply of a shop worker. "Here is what happened: the more complicated the machine is the more they think that there is less work on it for the worker, all he has to do is to push buttons. Therefore, the wage rates are lower. This equipment wonder of the Moscow "Krasnyy proletariy" Association will knock the wages down to 150!"

Here again we were greatly surprised and the feeling of having met with something puzzling did not leave us for the whole day.

"Yes, the operation has also become more complicated -- how much skill does even one readjustment require?!" -- explained the workers.

Readjustment is the business of the readjusters. Of course, it would be good if everyone could become a worker and an adjuster. But this is not permitted so far. It is not permitted because girls now working on the old machine tools do not have the practice or experience.

Too bad, we thought, walking to the door of the plant. The machine tools were brought here a long time ago, but so far there is nobody to work on them. Here my glance fell on a sign on a door, "Department of Technical Training."

Opinion Two.

Teymuraz Berianidze, chief of the department of technical training, sat very quietly at his desk and studied a wise economic volume.

"Eight-spindle ones? No, we do not train anybody to operate them. And we never thought about them. For many reasons...First, these machine tools are not operating because they were incomplete when they arrived. Secondly, we only train when a group of 10-15 people is selected. At present we have selected a group of technologists and are teaching them "Basic" and "Fortran" computer languages. This is an important matter and scientific technological progress is being felt here."

"Basic, Fortran?" exclaimed Vladimir Sheiko, manager of the computer laboratory. "Why? To master programing in 100 hours which takes five years of study in Vuz?! Why? We have staff programers who cope with the work. Why? They do not have their own computers -- we will give them two displays and will train them to use already prepared programs in two weeks!"

With these three "whys" Vladimir obliterated the impression of progress going on in the technical training department.

We returned there and one more time asked Teymuraz Berianidze how the reequipment plant of the enterprise correlates with the plans of the operation of the department. Everything was found to be very simple. Four workers in the department collect applications and send them to the Minvuz [Ministry of Higher and Secondary Specialized Education] which develops software for them. Training four adjusters for the eight-spindle machine tools standing idle did not fit in this arrangement.

Opinion Three.

Not one machine tool model manufactured by the plant carries the honorable pentagon. The State Emblem of Quality is shown on the door leading to the Komsomol Committee of the Plant. Why is it here, we thought, perhaps it defines the quality of the work of the youth leaders of the plant? Good, if it is so...

Nodar Chkholariya, secretary of the committee raises his hands:

"I was elected secretary only a month ago. But even in that time we did a lot. A certain amount of work was done and a number of specific measures was outlined. Raids and checks were carried out for the purpose of saving raw materials and other materials, electric power and working time. Much was done to organize the leisure time for the youths, sports areas, swimming pool..."

Leisure time is good. This can only be welcome. But particular production problems, one of which we met, should not be forgotten. In fact, to implement the planned task on old equipment, workers of many shops in the plant must remain after working hours. Sometimes nine to ten hours. After such a working day there would be no desire to swim or play chess. Therefore, while thinking of how to provide leisure time for youth, the Komsomol Committee must obviously also be concerned with labor conditions and high productivity. All this depends primarily on the reequipment of the plant...

"My deputy, David Khrikadze, can tell you more about this," Nodar advised. "He has already been working here for almost six months..."

David began to talk. But we had already heard about the "certain work," done by the Komsomol Committee and about a "number of outlined measures." Therefore, we decided to interrupt David as tactfully as possible and ask both Komsomol leaders one specific question: about their work in the introduction and assimilation of new equipment received at the plant.

"Of course! We introduce and assimilate. For example, a group of young specialists was formed in the department of the chief technologist which is doing efficient, purposeful work in this direction. When there is a need for these specialists to service new equipment we send the best young workers to the OTO [Technical training department] for retraining."

The reader is already acquainted with what they teach in the department of technical training. The rest, if David is to be believed, is proceeding swimmingly. They assimilate, introduce and direct. True, they could not cite even one specific example to us. They knew about machine tools standing in the 19th shop that no one needed and they honestly acknowledged that they could not do anything for their rapid introduction. Actually, this point was not mentioned in the "specific measures" outlined by the Komsomol Committee. This means that the honorable pentagon that beautifies the entrance door does not reflect the quality of the work of the Komsomol Conmmittee...

A Small Discovery

(instead of the fourth opinion)

We discovered a new variety of flaws. Moris Chitayev and Igor Chayka helped us make this sad discovery. Moris Chitayev, technologist, whom these ill-fated machine tools drive out of his mind, washed out the OTO version immediately: "They are a full set of good machine tools, of excellent quality. I will clarify that -- in a set such as we ordered. Is it the fault of the "Krasnyy proletariy" plant that the order was not for the set that we actually need?!"

Here is what occurred: semiautomatic lathes of this brand are ordered "in parts," i.e., with the set of regulating pinions precisely for the given specific enterprise. In planning future activity, nobody at the plant took that into consideration. And today Moris Chitayev sits day and night at the drawing board to modify the flaw. The flaw in planning which doomed the machine tools from the very first to a long sleep in one corner of the

nineteenth shop. So far these machine tools are only imaginary -- really there are none, although the plant duly pays for these illusions. They will come to life -- we are sure of that. But Igor Chayka, deputy chief technologist of the design bureau, is not sure that this will be a happy awakening.

"Such machine tools are good for large series production. The present and future of our machinebuilding plant is small series output. Therefore,... actually we need some other machine tools. Since, however, we have these -- their readjustment will become, with time, the basic kind of labor. But where are we to get adjusters?..."

In economics it is always thus: you close the door on new requirements -- they crawl back in through the window.

A small true story, resembling a parable can, perhaps, prove this. There is always a line in the dining room of the "Stankostroitel". Stand in it the whole leisure period and be late returning to the machine tool? Disrupt a hard-to-reach plan? Girls from the metal thermal treatment section, despairing of their legal satisfaction of their gastronomic pretensions, do it more simply: they leave the thermal oven connected during the rest period and fry an omelet with sausage in it for themselves. Although this is a true story, it is also a parable: anyway sooner or later economics will force planning to raise the skills of workers simultaneously with the reequipment of enterprises. But better sooner than later.

...Our colleague found his writing pad: it was an entirely different shop and an entirely different enterprise. Thus, the search for flaws did not end...

2291
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INDUSTRY PLANNING AND ECONOMICS

HIGHER PRODUCTION, LOWER METAL CONTENT TO GUIDE INDUSTRY

Moscow MASHINOSTROITEL in Russian No 4, Apr 86 pp 1-2

[Article by V.N. Shvedov, M.I. Shvedov, Candidate of Historical Sciences, and V.I. Gazetov: "At A Historic Turning Point"]

[Excerpts] In accordance with party plans, industries throughout the economy will be overhauled and the infrastructure of society radically transformed over the next 15 years, thus pushing our country into the front ranks of science, technology, and engineering by the end of that time. The party and the Soviet people will have to work with unprecedented energy if the goals and tasks in its program are to be reached and accomplished. These goals and tasks have been presented with unmistakable clarity in documents adopted by the highest party forum.

The final word in implementing party plans belongs to the machine building industry. It is systems and complexes of technically sophisticated, cost-effective machines, equipment, and tools that must serve as the foundation on which revolutionary changes in manufacturing techniques and the organization of production will be effected. In addition, they will be the cornerstone for raising labor productivity, reducing the amount of materials and energy used per unit of output throughout all branches of industry, and improving quality. For this reason, modernizing the machine building industry from the ground up and ensuring that it grows at a rapid rate are a priority task for the 12th Five-Year Plan and the period ending in the year 2000. Overhauling plant and equipment represents the fastest route to modernizing enterprise facilities; in addition, it is half as expensive as new construction. By the end of the 12th Five-Year Plan, up to 50 percent of all capital spending will go for realigning industries and overhauling plant and facilities.

In 1986-1990, the increase in industrial output will be between 21 and 24 percent, while output in the machine building and metal processing sectors will increase by 40-45 percent. At the same time, the tool, instrument, electrical, and electronic industries will register a growth in output that is 30 to 60 percent higher than the machine building industry's as a whole, while the amount of computer hardware will increase by a factor of 2-2.3.

Industry will update one-third of the producer goods currently being manufactured annually; machine builders will do the same, but at a level of 10-12 percent annually. Plans call for reducing the period of time necessary

to get a piece of equipment from the drawing board to the production line by a factor of 3-4. Such new equipment must be 1.5 to 2 times more productive and reliable than current models. The integration of science and industry in future years will play an extremely important part in accomplishing this task.

In the 12th Five-Year Plan, the amount of metal used in building a machine or piece of equipment should decline by 12-18 percent, while the amount of energy needed for the same purpose should be 7-12 percent lower. Over the same period of time, labor productivity in the machine building industry will increase by 39-43 percent, while the manufacturing cost of an item will drop by 9-11 percent.

In order to improve management in the machine building industry and turn the industry into a sophisticated springboard for technological progress, the CPSU Central Committee and USSR Council of Ministers have adopted a resolution mandating the creation of a USSR Council of Ministers Bureau of Machine Building. The bureau's activities would be centered around carrying out a common technological policy and developing cooperation in the area of machine building with CEMA member countries.

Plans for the future social and economic development of the country also include enhancing the welfare of the people by a quantum factor. The amount of resources devoted to improving living standards is projected to double over the upcoming 12th Five-Year Plan, while real income will increase by a factor of 1.6-1.8.

Critical prerequisites to the implementation of the party's strategy of accelerated social and economic progress include the following: use of scientific and technological developments to enhance the overall productivity and performance of industry; changes in structural and investment policy; improvement of management systems and techniques; enhancement of discipline and observance of procedure; motivation of personnel; and improvements in the activities of the party, as well as in its operating techniques and style.

The scientific and technical community is making a major contribution to achieving the goals prescribed in the party program. The more than 140,000 primary organizations within the scientific and technical community combine more than 12 million persons in their ranks. The unwavering attention of party and labor union organizations has enabled the scope of the scientific and technical community's activities to grow.

In 1985, many measures were implemented to speed scientific and technical progress. Scientific and technical societies played an active part in this work, which resulted in 14 scientific discoveries and the employment of more than 23,000 inventions and 4 million suggestions on how to enhance efficiency. In addition, industries have geared up for and begun production of 4,000 different products. Models have been made for 3,600 new machines, pieces of equipment, instruments, tools, and factory mechanization units. Almost 8,000 factory sections, shops, and plants now have integrated mechanization and automation. Over 11,000 mechanized mass-production, automated, and rotary production lines have been installed, along with more than 13,000 industrial robots.

The 6th plenum of the All-Union Council of Scientific and Technical Societies determined the major goals of the scientific and technical community's activities for this year during its meeting last December, In particular, the community will deal more with issues concerning development of the machine building and other industries involved in speeding scientific and technical progress. It will also deal with implementing plans to develop new technology, carrying out scientific and technical and social and economic programs, increasing the quality and reliability of output, and enhancing resource conservation programs. This year, the scientific and technical community will be more active in helping cut manual labor. As we know, innovation-minded workers in the Zaporozhye, Chelyabinsk, and Ku'byshev Oblasts and in the Lithuanisn and Latvian SSR's initiated a record-keeping program for all manually performed jobs, as well as target programs with cutting manual labor as their goal. One hundred and twenty areas of the country have similar programs. In the future, this movement will develop using the motto "Shift the burden of manual labor to machines."

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INDUSTRY PLANNING AND ECONOMICS

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UNIFIED SYSTEM OF DESIGN DOCUMENTATION UPDATED

Moscow STANDARTY I KACHESTVO in Russian No 4, Apr 86 pp 22-32

[Article by S. L. Taller and V. V. Gugnina of the All-Union Research Institute for Normalization in Mechanical Engineering under the "Interdepartmental Systems of Standards" rubric: "Classification of General Mechanical Engineering Assembly Units in the YeSKD System (Class 30)"]

[Text] Class 30 "Assembly units, general mechanical engineering" is central to the Unified System of Design Documentation (YeSKD), which has been developed for designation of articles and their design documentation through a depersonalized system [1-3].

Mechanical engineering assembly units include articles being developed or used in various sectors of engineering which have an established terminology and are not a specific adjunct of a particular industrial sector (reducing gears, couplings, pipes and so forth).

The network of subclasses and groups of class 30 is shown in Table 1.

The method of construction of class 30 is based on a deductive logical division of the classified group into subgroups (from the general to the particular) according to subordinate features. This is achieved by particularization of the features of the items in each successive stage of the classification division, thus creating a recognizable pattern.

The following basic features are used in the classification of the items: "functional", "for utility purposes", "structural", "parametric", "denomination".

The items are classified into subgroups and kinds according to features which clarify the classifications chosen at the upper levels.

The registration capacity of the generic groupings in the class has been formulated under the assumption that it will not be exhausted for 25-30 years. In order to make rational use of the classification capacity, in certain instances several genera of item have been combined into a single grouping (Table 2).

Table 1

CLASS 300000 — ASSEMBLY UNITS, GENERAL MECHANICAL ENGINEERING

SUBCLASSES		Groups 0	1	2	3	4	5	6	7	8	9
0	Документы (нормы, правила, требования, методы)	Для изделий всего класса или двух и более подклассов	Для устройств базовых	Для трубопроводов и их элементов	Для устройств, передающих движение	Для устройств, направляющих, ограничивающих и преобразующих движение	Для устройств защитных, закрывающих, облицовочных, уплотнительных, пояснительных. Для комплектов	Для устройств гидравлических, пневматических, смазочных	Для сосудов, кроме сосудов под избыточным давлением		
1	Устройства базовые		Корпуса, крышки (a)	Рамы, каркасы (b)	Опорные (c)	(d) Днища (донья)	Элементы крепления (e)	Крепеж (f)	(g) Элементы жесткости		
2	Трубопроводы и их элементы		(h) Трубопроводы: прямые (i)	(h) Трубопроводы: изогнутые в одной плоскости (j)	(h) Трубопроводы: изогнутые в разных плоскостях (k)	Соединения трубопроводов, рукава гибкие, шланги, воздуховоды (l)	Элементы трубопроводов (m)				
3	Устройства, передающие движение		Редукторы (n)	Мотор-редукторы (o)	Вариаторы, передачи, коробки передач (p)	Приводы, кроме мотор-редукторов (q)	Муфты, полумуфты (r)	Цепи, канаты, ремни, тросы, устройства включения и переключения (s)	Элементы механических передач (t)		
4	Устройства направляющие, ограничивающие и преобразующие движение		Устройства, направляющие движение (u)	Устройства, ограничивающие движение (v)	Устройства, направляющие и ограничивающие движение (w)	Подшипники скольжения (x)	Устройства, преобразующие движение (y)				
5	Устройства защитные, закрывающие, облицовочные, уплотнительные, пояснительные. Комплекты		Средства защиты и обслуживания рабочих мест и механизмов (z)	Средства индивидуальной защиты (aa)	Устройства уплотнительные и закрывающие (bb)	Устройства облицовочные, облицовочные, пояснительные, указательные, отсчетные (cc)	(dd) Листы: (ee) плоские: (ff) прямоугольные, косоугольные, комбинированные	(dd) Листы: (ee) плоские: (gg) круглые, секторные, сегментные	(dd) Листы: гнутые (hh)	Комплекты, упаковка без изделий (ii)	
6	Устройства гидравлические, пневматические и смазочные		Гидроаппаратура направляющая (jj)	Пневмоаппаратура направляющая (kk)	Гидроаппаратура регулирующая (ll)	Пневмоаппаратура регулирующая (mm)	Трансформаторы гидродинамические (nn)	Гидроцилиндры, пневмоцилиндры (oo)	Элементы гидравлических и пневматических систем. Станции, системы, устройства смазочные (pp)		
7	Сосуды, кроме сосудов под избыточным давлением		Цилиндрические с перегородками (qq)	Цилиндрические без перегородок (rr)	Призматические (ss)	Конические (tt)	Сферические, торообразные, бочкообразные (uu)	Комбинированные (vv)			
8											
9											

Table 1 - Key:

SUBCLASSES: 0 - documents (norms, rules, requirements, methods); 1 - basic structures; 2 - pipelines and their components; 3 - motion transmitting devices; 4 - motion guiding, limiting and transforming devices; 5 - protective, covering, facing, sealing, illuminating devices. Kits; 6 - hydraulic, pneumatic and lubricating devices; 7 - vessels, except those under excess pressure.

GROUPS: 0 - for items of the entire class or two or more subclasses; 1 - for basic structures; 2 - for pipelines and their components; 3 - for motion transmitting devices; 4 - for motion guiding, limiting and transforming devices; 5 - for protective, covering, facing, sealing and illuminating devices, for kits; 6 - for hydraulic, pneumatic, lubricating devices; 7 - for vessels, except those under excess pressure.

a. Housings, covers
b. Frames, frameworks
c. Bearings
d. Bottoms
e. Fastening elements
f. Fasteners
g. Stiffening elements
h. Pipelines
i. Straight
j. Curved in one plane
k. Curved in several planes
l. Pipeline connections, flexible hoses, hose pipes, air ducts
m. Pipeline elements
n. Reducers
o. Reducing motors
p. Variable-speed drives, transmissions, gear boxes
q. Drive units, except reducing motors
r. Couplings, half-couplings
s. Chains, ropes, straps, cables, activation and switching devices
t. Elements of mechanical transmissions
u. Motion guiding devices
v. Motion limiting devices
w. Motion guiding and limiting devices
x. Plain bearings
y. Motion transforming devices
z. Protection and utility equipment for work stations and machinery
aa. Personal protection gear
bb. Sealing and covering devices
cc. Fencing, facing, explanatory, instructional, metering devices
dd. Plates
ee. Flat
ff. Rectangular, canted, combination
gg. Rounded, sectoral, segmental
hh. Curved
ii. Kits, packaging without the items
jj. Hydraulic guiding apparatus
kk. Pneumatic guiding apparatus
ll. Hydraulic regulatory apparatus
mm. Pneumatic regulatory apparatus
nn. Hydrodynamic transformers
oo. Hydraulic cylinders, pneumatic cylinders
pp. Elements of hydraulic and pneumatic systems, lubricating stations, systems, devices
qq. Cylindrical vessels with partitions
rr. Cylindrical vessels without partitions
ss. Prismatic vessels
tt. Conical vessels
uu. Spherical, toroidal, barrel-shaped vessels
vv. Combination vessels

Table 2.

	301300	Bearing [Supporting]
301310	301311	Bed frames
Bearings	2	Platforms
	3	Slabs, benches
	4	Bases, shoes
	5	Beams, bars
	6	Cradles, stands pedestals
	7	Turrets, masts, booms
	8	
	9	

When necessary, classification groupings of "Other" have been provided. These are generally used in the latter stages of the classification. They contain items not included in previous groupings and whose features do not allow their admission; however, it is not advisable to create new groupings for a small number of such items. Furthermore, the "Other" groupings are required for individual items which will be developed in future and for which it is not presently expedient to appoint separate containment categories.

On the example of the classification of stiffening elements, we may illustrate one of the fundamental premises used in devising the titles of the classification groupings, namely, the creation of the grouping "Combination", in which items are classified according to a combination of two or more features used individually in preceding groupings (Table 3).

Class 30 of the YeSKD was developed in accordance with a technical request, coordinating with the ministries and agencies concerned, and approved by the Gosstandart (decree No. 100 of 06/09/79). It has undergone comprehensive practical validation (KPP) in the industrial sectors (30 ministries and agencies) at more than 500 enterprises and in organizations [4].

On the basis of proposals of the industrial sectors from the outcome of the KPP and a trial adoption of the YeSKD, modifications and additions to class 30 were worked out. These modifications were incorporated in the class and a typographical publication was prepared. The revision put several of the titles of the classification groupings in sequence, clarified the classification features in a number of groupings, abridged certain groupings, clarified the classification of kits [sets of parts], introduced a classification of packagings, and so on. The network of subclasses and groups of the revised class is shown in Table 4.

Subclass 301000 received the title "Housing, supporting, load-bearing and fastening structures", i.e., the mentioned items are also included in it.

An example of the clarification of classification features is shown in Tables 5-8.

Table 3.

CLASS 300000	Assembly Units, General Mechanical Engineering		
SUBCLASS 301000	Basic Structures		
GROUP 301700	Stiffening Elements		
SUBGROUP	GENUS		
301740 Longerons, stringers, beams, carlings, keels	301741	Longerons	profiled (with belts of profiles)
	2		monolithic
	3		girder type
	4		combination
	5	Beams	
	6	Stringers	
	7	Carlings	
	8	Keels	
	9		
301750 Ribs (stiff)	301751	Framing	
	2	Girding	
	3	Beam type	
	4	Combination	
	5		
	6		
	7		
	8		
	9		
301760 Ribs, intermediate (ordinary)	301761	Framing	
	2	Girding	
	3	Beam type	
	4	Combination	
	5		
	6		
	7		
	8		
	9		

Table 4.

CLASS 300000 — ASSEMBLY UNITS, GENERAL MECHANICAL ENGINEERING

SUBCLASSES — Groups

		0	1	2	3	4	5	6	7	8	9
0	Документы (нормы, правила, требования, методы)	Для изделий всего класса или двух и более подклассов	Для устройств корпусных, опорных, несущих и крепления	Для трубопроводов (систем трубопроводов) и их элементов	Для устройств, передающих движение	Для устройств направляющих, ограничивающих и преобразующих движение	Для устройств защитных, закрывающих, облицовочных, уплотнительных, пояснительных. Для комплектов	Для устройств гидравлических, пневматических, смазочных	Для сосудов, кроме сосудов под избыточным давлением		
1	Устройства корпусные, опорные, несущие и крепления		Корпуса (a)	Рамы, каркасы, крышки (b)	Устройства опорные (c)	Несущие конструкции (d)	Элементы крепления (e)	Крепеж (f)	Элементы жесткости (g)		
2	Трубопроводы (системы трубопроводов) и их элементы		(h) Трубопроводы (системы трубопроводов) прямые (i)	изогнутые в одной плоскости (j)	изогнутые в разных плоскостях (k)	Трубы прямые (l)	Трубы изогнутые (m)	Соединения трубопроводов, рукава гибкие, шланги, гидро- и пневморазъемы, элементы трубопроводов (n)			
3	Устройства, передающие движение		Редукторы (o)	Приводы (p) мотор-редукторы (q)	кроме мотор-редукторов (r)	Вариаторы, передачи, коробки передач, механизмы валковые, роликовые, колеса ходовые (s)	Муфты, полумуфты (t)	Цепи, канаты, ремни, устройства включения и переключения, шкивы, блоки, шпиндели, рычаги (u)	Элементы механических передач: валы, оси (v)	Элементы механических передач, кроме валов и осей (w)	
4	Устройства направляющие, ограничивающие и преобразующие движение		Устройства направляющие движение, перемешивающие (x)	Устройства, ограничивающие движение (y)	Устройства, направляющие и ограничивающие движение (z)	Подшипники скольжения (aa)	Устройства, преобразующие движение (bb)				
5	Устройства защитные, закрывающие, облицовочные, уплотнительные, пояснительные. Комплекты		Средства защиты и обслуживания рабочих мест (cc)	Средства индивидуальной защиты (dd)	Устройства уплотнительные, закрывающие (ee)	Устройства обрамляющие, облицовочные, пояснительные, указательные, отсчетные (ff)	Листы (gg)	Комплекты (hh)			
6	Устройства гидравлические, пневматические, смазочные		Гидроаппараты (ii)	Пневмоаппараты, пневмогидроаппараты (jj)	Трансформаторы гидродинамические (kk)	Гидроцилиндры, пневмоцилиндры (ll)	Элементы гидравлических и пневматических систем, устройства смазочные (mm)				
7	Сосуды, кроме сосудов под избыточным давлением		Цилиндрические без перегородок (nn)	Цилиндрические с перегородками (oo)	Призматические (pp)	Конические (qq)	Сферические, торообразные, бочкообразные (rr)	Комбинированные (ss)			
8											
9											

Table 4 - Key:

SUBCLASSES: 0 - documents (norms, rules, requirements, methods; 1 - housing, supporting, load-bearing and fastening structures; 2 - pipelines (pipeline systems) and their elements; 3 - motion transmitting devices; 4 - motion guiding, limiting and transforming devices; 5 - protective, covering, facing, sealing, illuminating devices. Kits; 6 - hydraulic, pneumatic and lubricating devices; 7 - vessels, except those under excess pressure.

GROUPS: 0 - for items of the entire class or two or more subclasses; 1 - for basic structures; 2 - for pipelines and their elements; 3 - for motion transmitting devices; 4 - for motion guiding, limiting and transforming devices; 5 - for protective, covering, facing, sealing and illuminating devices; for its; 6 - for hydraulic, pneumatic, lubricating devices; 7 - for vessels, except those under excess pressure.

a. Housings, covers
b. Frames, frameworks
c. Supporting structures
d. Load-bearing structures
e. Fastening elements
f. Fasteners
g. Stiffening elements
h. Pipelines (pipeline systems)
i. Straight
j. Curved in one plane
k. Curved in several planes
l. Straight pipes
m. Curved pipes
n. Pipeline connections, flexible hoses, hose pipes, hydraulic and pneumatic joints, pipeline elements
o. Reducing gears
p. Drive units
q. Reducing motors
r. Except reducing motors
s. Variable-speed drives, transmissions, gear boxes, roll and roller mechanisms, running wheels
t. Couplings, half-couplings
u. Chains, ropes, belts, clutches, shifting devices, pulleys, blocks, spindles, levers
v. Elements of mechanical transmissions: shafts, axles
w. Elements of mechanical transmissions, except shafts and axles
x. Motion steering devices, mixers
y. Motion limiting devices
z. Motion steering and limiting devices
aa. Plain bearings
bb. Motion transforming devices
cc. Protective and utility equipment for work stations
dd. Personal protection gear
ee. Sealing and covering structures
ff. Fencing, facing, explanatory, instructional, metering devices
gg. Plates
hh. Kits
ii. Hydraulic apparatus
jj. Pneumatic apparatus, pneumohydraulic apparatus
kk. Hydrodynamic transformers
ll. Hydraulic cylinders, pneumatic cylinders
mm. Elements of hydraulic and pneumatic systems, lubricating devices
nn. Cylindrical without partitions
oo. Cylindrical with partitions
pp. Prismatic
qq. Conical
rr. Spherical, toroidal, barrel-shaped
ss. Combination

Table 5.

303360 Hydraulic drives, pump-controlled	303361	Linear travel	membrane
	2		piston
	3		bellows
	4	Rotary travel	
	5	Limited rotary motion	
	6		
	7		
	8	Combination	
	9	Other	
303370 Hydraulic drives, positive-displacement, accumulator and manifold, combination	303371	Accumulator	linear motion
	2		rotary motion
	3		limited rotary motion
	4		combination
	5	Manifold	linear motion
	6		rotary motion
	7		limited rotary motion
	8		combination
	9	Combination	

Several classification groupings were abridged. For example, groups 305500 "Plates, flat, rectangular, canted, combination", 305600 "Plates, flat round, sectoral, segmental" and 305700 "Plates curved" were replaced by group 305500 "Plates". The classification of group 305500 is shown in Table 9.

The classification of kits [sets of parts] was given in a more ample revision (Table 10).

Several items, such as 302440 "Air ducts and their elements", have been excluded from class 30 and included in class 63 "Equipment, construction, road-building, sewage, air conditioning and ventilation. Fire safety".

The comprehensive practical verification demonstrated the necessity of including in class 30 a number of articles previously found in other classes. An example of the creation of new classification groupings is given in Table 11.

For ease of using class 30, an alphabetic index of the titles of articles (APU) was developed in order to retrieve items by designation. This will enable a subsequent encoding of blueprints in terms of classification features. The APU alphabetically lists the titles of articles (assembly units) contained in the classification groupings.

Table 6.

КЛАСС 300000 (a)	Сборочные единицы общемашиностроительные
ПОДКЛАСС 306000 (b)	Устройства гидравлические, пневматические, смазочные
ГРУППА 306100 (c)	Гидроаппараты

ПОДГРУППА (d)	ВИД (e)		
306110 Направляющие. Распределители золотниковые (f)	306111 2 3	Двухпозиционные (g)	двухлинейные (h) трехлинейные (i) четырехлинейные и более (j)
	4 5 6 7 8 9	Трехпозиционные (k) Четырехпозиционные и более (l) Комбинированные (m)	
306120 Направляющие. Распределители крановые (n)	306121 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5 6 7 8 9	Трехпозиционные Четырехпозиционные и более Комбинированные	
306130 Направляющие. Распределители клапанные (o)	306131 2 3	Двухп зиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5 6 7 8 9	Трехпозиционные Четырехпозиционные Комбинированные	
306140 Регулирующие. Аппараты управления расходом (p)	306141 2	Дроссели (q) Регуляторы расхода (r)	
	3 4	(s) Синхронизаторы расходов	дроссельные (t): делители потока (v) сумматоры потока (w)
	5 6		объемные (u): делители потока сумматоры потока
	7 8 9	Прочие (x)	

ПОДГРУППА	ВИД		
306150 Регулирующие. Распределители золотниковые дросселирующие (y)	300151 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5 6 7 8 9	Трехпозиционные Четырехпозиционные и более Комбинированные	
306160 Регулирующие. Распределители золотниковые крановые (z)	306161 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5 6 7 8 9	Трехпозиционные Четырехпозиционные и более Комбинированные	
306170	306171 2 3 4 5 6 7 8 9		
306180	306181 2 3 4 5 6 7 8 9		
306190	306191 2 3 4 5 6 7 8 9		

Table 6 - Key:

a. Class 300000 assembly units, general mechanical engineering
b. Subclass 306000, hydraulic, pneumatic, lubricating devices
c. Group 306100 hydraulic apparatus
d. Subgroup
e. Genus [type]
f. 306110 guiding, distribution valves, spool type
g. Two-position
h. Two-line
i. Three-line
j. Four-line or more
k. Three-position
l. Four-position or more
m. Combination
n. 306120 guiding, distribution valves, rotary type
o. 306130 guiding, distribution valves, seat type
p. 306140 regulating, flow control apparatus
q. Throttles
r. Flow regulators
s. Flow synchronizers
t. Throttle type
u. Positive-displacement type
v. Flow dividers
w. Flow adders
x. Other
y. 306150 regulating, distribution valves, spool type, throttling
z. 306160 regulating, distribution valves, spool type, rotary type

For example:

А	
Амортизаторы	304243
Арретиры	304247
Б	
Бандажи	301543
Бобышки	301717
К	
Карданы	304113

For the classification of general design documents, class 30 (like other classes of the YeSKD) employs the subclass "0", which categorizes the documents governing the norms, rules, requirements and methods which are common to the entire class, its subclasses, groups, subgroups and genera in the field of properties of items, their labeling, packaging, inspection, reception, transportation, storage, installation, operation, repair, production technology, and so forth.

The standards of all categories and other documents whose classification and designation are stipulated by the GSS and other systems of general technical standards, individual design documents established by the YeSKD standards, and technological documents provided by the YeSTD standards, are not categorized in subclass "0".

The properties of articles include: the operational designation of the items; their completed grouping; the construction; dimensional, mechanical, physicochemical, electrical, climatic, technical-economic characteristics and parameters; reliability; external appearance; weight; the properties of the material of the articles and other structural-operational parameters.

Table 7.

КЛАСС 300000 (a)	Сборочные единицы общемашиностроительные
ПОДКЛАСС 306000 (b)	Устройства гидравлические, пневматические, смазочные
ГРУППА 306200 (c)	Пневмоаппараты, пневмогидроаппараты

ПОДГРУППА (d)	ВИД (e)		
306210 Пневмоаппараты направляющие. Распределители золотниковые (f)	306211 2 3	Двухпозиционные (g) (h) (j)	двухлинейные (i) трехлинейные четырехлинейные и более
	4 5	Трехпозиционные (k) Четырехпозиционные и более (l)	
	6 7 8 9	Комбинированные (m)	
306220 Пневмоаппараты направляющие. Распределители крановые (n)	306221 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5	Трехпозиционные Четырехпозиционные и более	
	6 7 8 9	Комбинированные	
306230 Пневмоаппараты направлющие. Распределители клапанные (o)	306231 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5	Трехпозиционные Четырехпозиционные и более	
	6 7 8 9	Комбинированные Прочие (p)	
306240 Пневмоаппараты регулирующие. Аппараты управления расходом (q)	306241 2 3 4 5 6 7 8 9	Дроссели (r) Распределители (s) Прочие (p)	

ПОДГРУППА	ВИД		
306250 Пневмогидроаппараты направляющие. Распределители золотниковые (t)	306251 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5	Трехпозиционные Четырехпозиционные и более	
	6 7 8 9	Комбинированные	
306260 Пневмогидроаппараты направляющие. Распределители крановые (u)	306261 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5	Трехпозиционные Четырехпозиционные и более	
	6 7 8 9	Комбинированные	
306270 Пневмогидроаппараты направляющие. Распределители клапанные (v)	306271 2 3	Двухпозиционные	двухлинейные трехлинейные четырехлинейные и более
	4 5	Трехпозиционные Четырехпозиционные и более	
	6 7 8 9	Комбинированные	
306280 Пневмоаппараты регулирующие. Аппараты управления расходом (w)	306281 2 3 4 5 6 7 8 9	Дроссели Распределители Прочие	
306290	306291 2 3 4 5 6 7 8 9		

Table 7 - Key:

a. Class 300000, assembly units, general mechanical engineering
b. Subclass 306000, hydraulic, pneumatic, lubricating devices
c. Group 306200, pneumatic apparatus, pneumohydraulic apparatus
d. Subgroup
e. Genus [type]
f. 306210, guiding pneumatic apparatus, distribution valves, spool type
g. Two position
h. Two-line
i. Three-line
j. Four-line or more
k. Three-position
l. Four-position or more
m. Combination
n. 306220, pneumatic guide apparatus, distribution valves, rotary type
o. 306230, pneumatic guide apparatus, distribution valves, seat type
p. Other
q. 306240, pneumatic regulation apparatus, flow control apparatus
r. Throttles
s. Distribution valves
t. 306250, pneumhydraulic guide apparatus, distribution valves, spool type
u. 306260, pneumohydraulic guide apparatus, rotary type
v. 306270, pneumohydraulic guide apparatus, distribution valves, seat type
w. Pneumatic [sic: pneumohydraulic?] regulatory apparatus, flow control apparatus

Given the goals of the classification (quick and easy retrieval of documents, a rational record-keeping, storage and circulation system for them), the primary classification features were chosen to be: the particular class, subclass, group of items which the document covers and the nature of the norm, rule, requirement, method, etc., governed by the document, regardless of its title (instruction, specification, general specification, etc.).

The groups in subclass "0" are used as follows: group "0" for documents establishing norms, rules, requirements or methods that are common to the items of the entire class or two or more subclasses; groups 1-9 for documents setting norms, rules, requirements, methods for items of subclass 1-9, respectively.

The subgroups in group "0" are used as follows: subgroup "0" for documents establishing the properties and other characteristics of the items; subgroups 1-9 are kept in reserve.

Subgroup "0" in group "0" is broken up into genera according to the nature of the properties and other characteristics of the items.

Subgroup "0" in groups 1-9 is used for documents establishing the norms, rules, requirements, and methods that are common to the items of the entire subclass or two or more groups.

Table 8.

КЛАСС 300000 (a)	Сборочные единицы общемашиностроительные
ПОДКЛАСС 302000 (b)	Трубопроводы (системы трубопроводов) и их элементы
ГРУППА 302300 (c)	Трубопроводы (системы трубопроводов), изогнутые в разных плоскостях

ПОДГРУППА (d)	ВИД (e)			
302310 Равнопроходные с D_y до 25 мм вкл. (f)	302311 2	Без элементов разъема (g)		без отводов (l) с отводами (m)
	3 4	С элементами разъема (h)	фланцевыми (i)	без отводов с отводами
	5 6		муфтовыми (j)	без отводов с отводами
	7 8		штуцерно-ниппельными (k)	без отводов с отводами
	9		комбинированными (n)	
302320 Равнопроходные с D_y св. 25 до 50 мм вкл. (o)	302321 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	
302330 Равнопроходные с D_y св. 50 до 100 мм вкл. (p)	302331 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	
302430 Равнопроходные с D_y св. 100 до 200 мм вкл. (q)	302341 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	

ПОДГРУППА	ВИД			
302350 Равнопроходные с D_y св. 200 до 400 мм вкл. (r)	302351 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	
302360 Равнопроходные с D_y св. 400 до 600 мм вкл. (s)	302361 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	
302370 Равнопроходные с D_y св. 600 мм (t)	302371 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	
302380 Разнопроходные (с увеличением или уменьшением диаметра) (u)	302381 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	
302390 Из труб некруглого сечения и комбинированные из труб круглого и некруглого сечения (v)	302391 2	Без элементов разъема		без отводов с отводами
	3 4	С элементами разъема	фланцевыми	без отводов с отводами
	5 6		муфтовыми	без отводов с отводами
	7 8		штуцерно-ниппельными	без отводов с отводами
	9		комбинированными	

Table 8 - Key:

a. Class 300000, assembly units, general mechanical engineering
b. Subclass 302000, pipelines (pipeline systems) and their elements
c. Group 302300, pipelines (pipeline systems), curved in different planes
d. Subgroup
e. Genus [type]
f. 302310 equal-channel with D_y up to and including 25 mm
g. No joint elements
h. With joint elements
i. Flange type
j. Coupling type
k. Union and shoulder nipple type
l. Without branches
m. With branches
n. Combination
o. 302320 equal-channel with D_y above 25 mm and up to and including 50 mm
p. 302330 equal-channel with D_y above 50 and up to and including 100 mm
q. 302430 equal-channel with D_y above 100 and up to and including 200 mm
r. 302350 equal-channel with D_y above 200 and up to and including 400 mm
s. 302360 equal-channel with D_y above 400 and up to and including 600 mm
t. 302370 equal-channel with D_y above 600 mm
u. 302380 unequal-channel (diameter increasing or decreasing)
v. 302390 constructed of non-round pipes or combinations of round and nonround pipes

Subgroups 1-9 in the groups are used for documents setting the norms, rules, requirements, and methods that are common to the items of groups 1-9, respectively, of the given subclass.

Subgroups 0-9 in groups 1-9 are broken down into genera according to the nature of the properties and other characteristics of the items.

Since the breakdown of subclass "0" into groups corresponds to the breakdown of the items into subclasses, while the breakdown of groups into subgroups corresponds to the breakdown of the items into groups, the numbers of the groups of general norms, rules, requirements and methods coincide with the numbers of the subclasses of items to which they refer, while the numbers of subgroups coincide with the numbers of the groups of items.

Such coincidence is achieved by a mnemonic association of the classification characteristics of the items with the documents (norms, rules, requirements, methods) referring to them, thereby facilitating retrieval by subject.

Since the five-stage classification (six-figure classification characteristic) also covers the classification of documents establishing general norms, rules, specifications and methods, these documents pertaining to the items of the subgroups and genera should be given classification characteristics in terms of the corresponding group to which these subgroups and genera belong. An example of the classification of documents in subclass "0" of class 30 is shown in Table 12.

Table 9.

КЛАСС 300000 (a)	Сборочные единицы общемашиностроительные
ПОДКЛАСС 305000 (b)	Устройства защитные, закрывающие, облицовочные, уплотнительные, пояснительные
ГРУППА 305500 (c)	Листы

ПОДГРУППА (d)	ВИД (e)			
305510 Плоские прямоугольные, косоугольные (f)	305511 2 3 4 5 6 7 8 9	Прямоугольные (g)	без отверстий	без изделий k с изделиями l
			с отверстиями	без изделий с изделиями
		Косоугольные (h)	без отверстий i	без изделий с изделиями
			с отверстиями j	без изделий с изделиями
305520 Плоские круглые, секторные (m)	305521 2 3 4 5 6 7 8 9	Круглые (n)	без отверстий	без изделий с изделиями
			с отверстиями	без изделий с изделиями
		Секторные (o)	без отверстий	без изделий с изделиями
			с отверстиями	без изделий с изделиями
305530 Плоские сегментные, комбинированные (p)	305531 2 3 4 5 6 7 8 9	Сегментные (q)	без отверстий	без изделий с изделиями
			с отверстиями	без изделий с изделиями
		Комбинированные (r)	без отверстий	без изделий с изделиями
			с отверстиями	без изделий с изделиями
305540 Гнутые с угловыми изгибами (s)	305541 2 3 4 5 6 7 8 9	С одним изгибом (t)		без изделий с изделиями
		С двумя изгибами (u)		без изделий с изделиями
		С тремя изгибами и более (v)		без изделий с изделиями

ПОДГРУППА	ВИД		
305550 Гнутые с радиальными изгибами (w)	305551 2 3 4 5 6 7 8 9	С одним изгибом t	без изделий с изделиями
		С двумя изгибами u	без изделий с изделиями
		С тремя и более изгибами v	без изделий с изделиями
305560 Гнутые с комбинированными изгибами (x)	305561 2 3 4 5 6 7 8 9	С двумя изгибами	без изделий с изделиями
		С тремя и более изгибами	без изделий с изделиями
305570	305571 2 3 4 5 6 7 8 9		
305580	305581 2 3 4 5 6 7 8 9		
305590	305591 2 3 4 5 6 7 8 9		

Table 9 - Key:

a. Class 300000, assembly units, general mechanical engineering
b. Subclass 305000, protective, covering, facing, sealing, explanatory devices
c. Group 305500 plates
d. Subgroup
e. Genus [type]
f. 305510 flat rectangular, canted
g. Rectangular
h. Canted
i. Without openings
j. With openings
k. Without parts
l. With parts
m. 305520 flat round, sectoral
n. Round
o. Sectoral
p. 305530 flat segmental, combination
q. Segmental
r. Combination
s. 305540 curved with corner bending
t. With one bend
u. With two bends
v. With three or more bends
w. Curved with radial bending
x. 305560 curved with combination bending

Subclass "0" may be used to encode design documents which previously had been designated in a troublesome and unsystematic manner in the sectors of industry. For example, a design document for general rules of rust prevention for reducing gears in compliance with GOST 2.201-80 is designated as follows:

АБВГ.300313.001

A similar classification of documents is given in other classes of the YeSKD system.

For a one-to-one understanding of the titles of articles in the classification process it is expedient to create a Determiner of Item Denominations, which should contain the names of the items along with code designations, presented in an alphabetic index, with an explanation of them. The titles in the Determiner should be alphabetically arranged. The Determiner of Item Denominations of class 30 should be created similar to the Determiner of Item Denominations for classes 71-76 of the YeSKD system, but without the sketches of typical representatives [5]. An example is given in Table 13.

It is advisable to introduce class 30, the same as other classes of the YeSKD, in new projects, in order to gradually bring into play the depersonalized classification system of article and design document designations, as established by GOST 2.201-80. Previously published design documents should be redesignated as needed in the volumes and timeframe established by the enterprises and organizations of the ministries and agencies. The primary consideration should be to redesignate the widely used, imitated article designs.

Table 10.

КЛАСС 300000 (a)	Сборочные единицы общемашиностроительные		ПОДГРУППА	ВИД	
ПОДКЛАСС 305000 (b)	Устройства защитные, закрывающие, облицовочные, уплотнительные, пояснительные. Комплекты		305650 Комплекты, кроме комплектов изделий и упаковки	305651	Монтажных частей (bb)
				2	Сменных частей (cc)
				3	Запасных частей dd
				4	Инструмента и принадлежностей (ee)
ГРУППА 305600 (c)	Комплекты		(aa)	5	Материалов (ff)
				6	
				7	
ПОДГРУППА (d)	ВИД (e)			8	Комбинированные (v)
				9	Прочие (gg)
305610 Комплекты изделий одного класса (f)	305611	g Устройств корпусных, опорных, несущих и крепления	305660	305661	
	2	h Трубопроводов и их элементов (h) (i)		2	
	3	Устройств, передающих движение		3	
	4	Устройств, направляющих, ограничивающих и преобразующих движение (j)		4	
	5	Устройств защитных, закрывающих, облицовочных, уплотнительных, пояснительных (k)		5	
	6	Устройств гидравлических, пневматических, смазочных (l)		6	
	7	Сосудов, кроме сосудов под избыточным давлением		7	
	8	(m)		8	
	9			9	
305620 Комплекты изделий двух и более классов (n)	305621	Без тары (o)	305670	305671	
	2	С тарой (p)		2	
	3			3	
	4			4	
	5			5	
	6			6	
	7			7	
	8			8	
	9			9	
305630 Комплекты упаковки без изделий (q)	305631	Без тары	305680	305681	
	2	С тарой — деревянной (r) — ящичной (s)		2	
	3	С тарой — деревянной — каркасно-щитовой (t)		3	
	4	С тарой — деревянной — u барабанной, бочковой		4	
	5	С тарой — деревянной — v комбинированной		5	
	6	С тарой — картонно-бумажной (w)		6	
	7	С тарой — металлической (x)		7	
	8	С тарой — y стеклянной, из полимерных материалов		8	
	9	С тарой — комбинированной (z)		9	
305640 Комплекты упаковки с изделиями (z)	305641	Без тары	305690	305691	
	2	С тарой — деревянной — ящичной		2	
	3	С тарой — деревянной — каркасно-щитовой		3	
	4	С тарой — деревянной — барабанной, бочковой		4	
	5	С тарой — деревянной — комбинированной		5	
	6	С тарой — картонно-бумажной		6	
	7	С тарой — металлической		7	
	8	С тарой — стеклянной, из полимерных материалов		8	
	9	С тарой — комбинированной		9	

Table 10 - Key:

a. Class 300000, assembly units, general mechanical engineering
b. Subclass 305000, protective, covering, facing, sealing, explanatory devices, kits [sets of parts]
c. Group 305600 kits
d. Subgroup
e. Genus [type]
f. 305610 kits of one class of article
g. Housing, supporting, load-bearing and fastening structures
h. Pipelines and their elements
i. Motion transmitting devices
j. Motion guiding, limiting and transforming devices
k. Protective, covering, facing, sealing, explanatory devices
l. Hydraulic, pneumatic lubricating devices
m. Vessels, except vessels under excess pressure
n. 305620 kits of two or more classes of article
o. Without container [package]
p. With container [package]
q. 305630 kits of packaging without articles
r. Wooden
s. Box type
t. Casing-board
u. Drum, barrel
v. Combination
w. Cardboard-paper
x. Metal
y. Glass, polymers
z. 305640 kits of packaging with articles
aa. 305650 kits, except kits of articles and packaging
bb. Installation parts
cc. Interchangeable parts
dd. Spare parts
ee. Tools and accessories
ff. Expendables
gg. Other

Table 11.

304150 Mixing devices	304151	Blade (vane) type
	2	Comb type
	3	Screw type
	4	Scraper type
	5	Disk type
	6	
	7	
	8	
	9	Other
304160 Elements of mixing devices	304161	Blades (vanes)
	2	Combs
	3	Screws
	4	Scrapers
	5	Disks, paddle wheels
	6	
	7	
	8	
	9	Other

Table 12.

КЛАСС 300000 (a)	Сборочные единицы общемашиностроительные
ПОДКЛАСС 300000 (b)	Документы (нормы, правила, требования, методы)
ГРУППА 300300 (c)	Для устройств, передающих движение

ПОДГРУППА (d)	ВИД (e)	
300300 Для изделий всего подкласса или двух и более групп (f)	300300 1 2 3 4 5 6 7 8 9	По двум и более видам норм (g) Свойства изделий (h) Маркировка, консервация, упаковка (i) Контроль, приемка (j) Транспортирование, хранение (k) Монтаж, эксплуатация, ремонт (l) Материалы (m) Технология производства (n) Прочие (o)
300310 Для редукторов (p)	300310 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упаковка Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремонт Материалы Технология производства Прочие
300320 Для мотор-редукторов (q)	300320 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упаковка Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремонт Материалы Технология производства Прочие
300330 Для вариаторов, передач, коробок передач (r)	300330 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упаковка Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремонт Материалы Технология производства Прочие

ПОДГРУППА	ВИД	
300340 Для приводов, кроме мотор-редукторов (s)	300340 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упак Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремон Материалы Технология производства Прочие
300350 Для муфт, полумуфт (t)	300350 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упак Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремонт Материалы Технология производства Прочие
300360 Для цепей, канатов, ремней, устройств включения и переключения (u)	300360 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упа Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремон Материалы Технология производства Прочие
300370 Для элементов механических передач (v)	300370 1 2 3 4 5 6 7 8 9	По двум и более видам норм Свойства изделий Маркировка, консервация, упак Контроль, приемка Транспортирование, хранение Монтаж, эксплуатация, ремонт Материалы Технология производства Прочие
300380	300380 1 2 3 4 5 6 7 8 9	

Table 12 - Key:

a. Class 300000, assembly units, general mechanical engineering
b. Subclass 300000, documents (norms, rules, requirements, methods)
c. Group 300300, for motion transmitting devices
d. Subgroup
e. Genus [type]
f. 300300 for articles of the entire subclass or two or more groups
g. For two or more types of norm
h. Properties of articles
i. Labeling, rust prevention, packaging
j. Inspection, reception
k. Transport, storage
l. Installation, operation, repair
m. Expendables
n. Production technology
o. Other
p. 300310 for reducing gears
q. 300320 for reducing motors
r. 300330 for variable-speed drives, transmissions, gearboxes
s. 300340 for drive units, except reducing motors
t. 300350 for couplings, half-couplings
u. 300360 for chains, ropes, belts, clutches and shifting devices
v. 300370 for mechanical transmission elements

Table 13.

Title of Article and Code		Definition
Shock absorber	304243	The elastic element of a shock absorbing device, intended for protection against jolts and vibrations
Detent	304247	A stopping device, designed to halt moving parts of meters in the nonworking position
Band	301543	A device in the form of a ring or belt, seated on parts of machines or structures to increase their strength or diminish wear
Lug	301717	A stiffening element, designed for local strengthening or thickening of thin-walled articles
Universal joint	304113	A device enabling rotation of two shafts at a variable angle, thanks to a moving connection of the elements or elastic properties

In order to facilitate the introduction of GOST 2.201-80, the enterprises and organizations should be recommended to develop standard techniques and procedures on the basis of the departmental documents and procedural directions "Introduction of the Unified System of Article and Design Document Designations and the YeSKD Classification System" (RD 50-171-79).

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INDUSTRY PLANNING AND ECONOMICS

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CERTIFICATION OF WORK STATIONS IN UKRAINIAN MACHINE-BUILDING

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pp 49-58

[Article by candidate of economic sciences B. M. Kryzhanovskyy]

[Text] The fundamental goals of boosting the growth rate and intensification of the economy, stimulation of scientific and technical progress, and improvement in the planning and management, the structural policy and the investment policy, as formulated at the April (1985) plenary session of the CPSU Central Committee, are critically dependent on the fullest possible utilization of the organizational and economic reserves, which category includes a policy of scientific organization of work (NOP).

A vital precondition for the practical realization of the goals to stimulate the socioeconomic development with regard to the economy of the Ukrainian SSR is balance (proportionality) in the economic development, particularly between the material (implements of work) and personal (labor force) elements of the productive capacity. Achievement of such balance to suit the specific sectoral and territorial characteristics of the development of the economy will guarantee the requisite increase in volume of production and income, a husbanding of monetary investments and labor expenses, and an improvement in the technical-economic indexes of the activity of the enterprises, associations, sectors of industry and the republic's economy as a whole.

At present, in our republic (as well as the entire country) there still exist various kinds and forms of imbalance in the economic development, which adversely affects the primary production indexes.

The scale of the imbalance of productive resources in the republic's economy is indicated by the following facts. In 1971-1983 the overall volume of monetary investments in the development of the economic complex of the republic increased by a factor of 1.66, the placement in service of primary production assets by 1.63, the overall value of primary production assets by 2.35, while the number of workers and employees increased by a factor of 1.26 [1]. Naturally, in a context of swift retooling of industry with an orientation toward the latest achievements of scientific-technical progress, a quicker rate of growth of the primary production assets should be sustained,

as opposed to the numbers of industrial production personnel, for this is the material prerequisite of growth in the capital-labor ratio and the labor productivity. However, such discrepancy must remain within reasonable bounds. Today, the rapid growth in the primary assets and monetary investments is attended not only by notable increase in the capital-labor ratio of the industrial workforce, but also the creation of a large number of new and unoccupied work stations.

Thus, in the term 1971-1980, the value of capital investments in the Ukrainian industry devoted to the creation of unused work stations became 10 percent of the overall volume; had these assets been spent on replacement of obsolete and worn down primary assets, the mean annual rate of their removal could have been increased from 1.6 to 2.7 percent [2]. In the 11th Five Year Period, 18 billion rubles were spent on creation of primary production assets in the republic's economy as a whole, of which only 5 million rubles (28 percent) were spent on compensation for the removal of obsolete assets and 13 billion rubles (72 percent) on creation of new work stations [3]. In the regional conditions of the Ukrainian SSR, which are characterized by a complex labor-resource situation, this produces a corresponding shortage of workers and a surplus of work stations.

The leading sector in the industrial complex of the republic is machine building, the share of which in production of goods approaches 30 percent. The technical level and balance among the separate elements of production potential of this sector in no small way determine the acceleration of the scientific-technical progress in all branches of the economy. However, in recent years, a certain imbalance between material and personal elements (factors) of the productive capacities is also observable here.

For example, at the outset of the 11th Five Year Period (according to the data of a single investigation by the statistical agencies in February 1981), for the enterprises of the 11 machine building ministries of the republic taken as a whole, there were 87 lathe operators for every 100 metal cutting lathes, and of this number there were 80 at the enterprises of the Ministry of Agricultural Machinery, 73 at the Ministry of Construction and Road Building Machinery, and 69 at the Ministry of the Electrotechnical Industry. Subsequent calculations revealed [4] that, in 1984, the number of metal cutting lathes in the Ukrainian SSR was nearly twice as great as the number of lathe operators. On this account, each year the republic fails to collect more than 2 billion rubles of national income [5].

Of decisive importance in the complex of human factors engineering and organizational planning measures to assure a balance between production and labor potential is the certification and rationalization of the workplace--a new component of the NOP and the economic mechanism, called into being by the demands of contemporary economic science and government policy. Expansion of the scale of certification and rationalization of the workplace will promote a more efficient utilization, both of the primary production assets and capital investments, and of the labor resources. Taking this circumstance into account, the "Basic Guidelines for the Economic and Social Development of the USSR in the Years 1986-1990 and Up to the Year 2000" have set

the goal of "creating a unified, nationwide system of planning, accounting, certification and rationalization of the workplace" as one of the most critical [6]. This illustrates the urgency of examining the current status and of validating strategies to improve the organization of the work involving certification of work stations in the machine building industry of the Ukrainian SSR.

By certification of work stations we understand a complex of engineering, technical, organizational and social measures aimed at better utilization of the internal production reserves and solving of socioeconomic problems. Their end goal is to determine the actual state of the technical-organizational level of the work stations and to ascertain the degree of compliance with the standard labor organization projects and prevailing technical norms of utilization of manpower and materialized labor.

During the certification process, goals will be set to boost the productivity, improve the working conditions and the utilization of primary production assets, lower the net costs of products, and guarantee a production of articles of given quality with continual modernization of the technology. Certification orients the labor collectives toward boosting the machine and equipment shift operation ratio through better organization of the work process and production. Compared to other forms of improving the organization of production and work, the principal innovation of workplace certification rests on the fact that the work stations (and thereafter the section, the shop, the enterprise as a whole) are comprehensively evaluated in terms of technical-economic, organizational-economic and social factors. As a result, the opportunity is created for development and implementation of various measures to boost the production efficiency on a uniform methodological foundation, organically interconnected, with more concrete goals.

Generalization of the experience of the machine building enterprises of the Ukrainian SSR, as well as the literature sources [7-10], enables a formulation of the following basic merits (advantages) of workplace certification as compared to other NOP measures:

- possibility of identifying work stations not complying with progressive technical and organizational strategies, guidelines, or normative standards; development and implementation of measures for their rationalization, or for elimination of obsolete work stations if rationalization is inadvisable; creation of new work stations on a footing of progressive strategies and progressive experience;

- boosting the shift operation ratio of equipment, especially the most productive equipment, by transferring to these the production of articles being turned out by low-efficiency or underloaded work stations, as the latter are phased out;

- identification of reserves for lowering the labor intensity of products and implementation of corresponding measures to upgrade the production, work and technological processes;

- verification of the validity of the material and labor expenditure norms being used; development and implementation of measures to upgrade the standardization process and introduce technically validated norms;

- taking stock of work stations with prevalence of low-skill, manual, especially heavy physical labor and formulation of target programs for their ultimate mechanization and automation;

- assessment of the validity of employing various benefits and rewards for adverse working conditions and implementation of measures for replacement or modernization of work stations where such benefits and rewards are being practiced;

- substantial improvement in the productive and technological structure of capital investments, increased share of resources and better substantiated determination of ways to employ them in the reconstruction and retooling of active enterprises;

- more efficient production through reapportionment of the production program and of the corresponding material and labor resources from backward and unprofitable enterprises and industries to the high-efficiency industrial plants, which in certain cases are presently being used beneath their capacity;

- more valid setting of limits on the numbers of personnel of the enterprises (associations) and improved supervision of the utilization of the labor force;

- closer coordination between the creation of primary production assets and number of work stations, on the one hand, and the labor resources, both those being organized on the national or republican level, and those organized for particular regions or districts, on the other hand;

- creation of the prerequisites for a more concrete training and upgrading of skills of the workforce, taking into account the actual needs of the enterprises (production associations) of the machine building sectors;

- possibility of substantial improvement in the system of labor resource management on the part of the local councils of people's deputies.

In our country [i.e., the Ukraine], the Dnepropetrovsk Combine Factory imeni Voroshilov has become the foremost enterprise actively conducting a program of certification and rationalization of work stations, achieving significant economic gains. In particular, with the help of the scientists and experts of the Dnepropetrovsk State University, this organization was first in discovering that further growth of production was being held back, not by a deficiency of labor resources (manpower), but by a surplus of work stations, some of which the enterprise had itself created in a hasty and scientifically unfounded manner. Moreover, as an inventory of the work stations made clear, some of the equipment had become hopelessly backward.

In consideration of the positive experience amassed by the Dnepropetrovsk Combine Plant imeni Voroshilov and a number of other machine building enterprises of Moscow, Leningrad, Gorkiy, Lvov and Krasnodar in the area of inventory and rationalization of work stations from the standpoint of bringing them into compliance with the needs of NOP, the CPSU Central Committee in 1984 adopted the resolution "Concerning the work experience of the collective of the Dnepropetrovsk Combine Plant imeni Voroshilov in raising the effectiveness of utilization of production capacities on the basis of a program of workplace certification and rationalization." This resolution became a powerful motive in the activation of programs for workplace certification and rationalization in the industrial sectors (foremost the machine building sector) of the Ukrainian SSR. As a result, the isolated or episodic implementation of workplace improvement programs gave way to a massive workplace certification and rationalization.

The certification system is based on a point evaluation for analysis of the integrated, adjusted and specific indicators of the workplace levels. The integrated workplace level (Y^i_{pm}) is computed by the formula [11]:

$$Y^i_{\text{рм}} = \frac{\sum_{1}^{3} Y^c_i}{3}, \tag{1}$$

where Y^c_1 is the technical-economic level of the work station; Y^c_2 is the level of organization and standardization of the work station; Y^c_3 is the level of the working conditions at the work station (RM); Y_i is the adjusted level of the work station according to the particular characteristics.

In evaluating the technical-economic level of the work station (adjusted index Y^c_1) it is recommended to employ the specific indexes characterizing the economic effectiveness of the RM (Φ_1), the technical level of the RM (Φ_2), the level of equipment of the RM (Φ_3), and the occupied time of the worker per shift (Φ_4); to measure the level of organization and standardization of work (adjusted index Y^c_2) it is recommended to use the indexes of RM space and planning (Φ_5), organization of the RM attendance (Φ_6), division of labor and cooperation (Φ_7), and quality of work standardization (Φ_8); to evaluate the level of working conditions (adjusted index Y^c_3) it is recommended to use the sanitary-hygienic working conditions (Φ_9), the level of mechanization and whether or not heavy physical work is involved (Φ_{10}), the labor safety rules (Φ_{11}), the psychological-physiological working conditions and the esthetics of the work station (Φ_{12}).

Analysis of any of the specific indexes (from Φ_1 to Φ_{12}) characterizing the work station is done by comparing the actually achieved values with the norm. The norm is taken to be the requirement of approved standards (GOST, OST or RST), the standard work organization projects (charts), or the interdepartmental, departmental and progressive factory norms. If for whatever reason there is no norm, an expert appraisal is warranted. This should take into account the recent Soviet and worldwide attainments and the accumulated progressive experience of the sector being analyzed.

If the actual values of the parameters of a factor fully comply with the norm as established during the course of the certification by the committees of the workshops and other structural subdivisions, each specific index (from Φ_1 to Φ_{12}) receives an evaluation of 0.25; in event of total or partial noncompliance between the actual values of the parameters and the norm, the factor receives a zero score.

In view of the above, the adjusted indexes for the technical level of the work station, the level of organization and standardization of the work at the station, and the level of the working conditions are defined as the sum of the numerical values of the specific indexes (factors) which determine them, i.e.,

$$Y_1^c = \sum_1^4 \Phi_i; \tag{2}$$

$$Y_2^c = \sum_5^8 \Phi_i; \tag{3}$$

$$Y_3^c = \sum_9^{12} \Phi_i. \tag{4}$$

A work station (the "arena of work" in the expressive phrase of Karl Marx) [12] is deemed certified under the following conditions: 1) the number of specific indexes not complying with the norm which are used in the evaluation of Y_1^c, Y_2^c and Y_3^c should not exceed one; 2) the number of adjusted indexes having a score of 0.75 (i.e., one of the specific indexes does not comply with the norm and is equal to zero) should not be greater than two out of three; 3) the integrated value of the index Y_{pm}^i should be no lower than 0.85.

The scale and effectiveness of the workplace certification program are impressive, as indicated by the efforts of both the sectoral and the territorial economic management agencies. As shown by a correlation of the data of the Ukrainian SSR State Work Commission [13], as well as data of other offices obtained by the author during direct study of the experience of certification at the ministries and offices, notable contrasts still prevail

in both the scale and (particularly) in the outcome of the workplace certification measures. Insofar as the ministries and offices expeditiously furnish their enterprises and organizations with procedural recommendations or instructions on the workplace certification and rationalization program, establish the time frame, continually supervise the implementation and concern themselves with the results, high effectiveness is generally achieved. Where this is not practiced, the return on time and resources spent for the workplace certification and rationalization is very poor.

In particular, as the investigations revealed, the workplace certification program is well organized at the enterprises and associations of the Ministry of the Automobile Industry, Ministry of Agricultural Machinery, Ministry of Energy, Ministry of the Petrochemical Industry, Ministry of Ferrous Metals, Ministry of the Chemical Industry, Ministry of Fertilizers, as well as the Ministry of the Coal Industry, Ministry of Ferrous Metals, Ministry of Residential Construction and Ministry of the Food Industry of the Ukrainian SSR, where in 1984 1.5-4.0 times more workers and 1.2-2 times more work stations per thousand work stations undergoing certification were released, as compared to the average of the republic's industries. This testifies to the goal-oriented work of the engineers, technicians and economists, the communist party and labor union organizations of the enterprises in the above ministries and agencies in the implementation of the workplace certification program and promotion of the principles of NOP.

At the same time, the analysis revealed that the indexes of worker and work station release per thousand at the enterprises and associations of 38 investigated ministries and agencies of Union and Union-republic level did not exceed 50 percent of the average republic level in 10 of them (26.3 percent of the total number), varied between 51 and 70 percent in 8 of them (21.1 percent), and varied between 71 and 99 percent in 3 of them (7.9 percent). Specifically, the criteria of effectiveness of the workplace certification are very low at the enterprises (associations) of the Ministry of the Petrochemical Industry, Ministry of the Coal Industry, Ministry of Power Machinery, Ministry of Instruments and Appliances, Ministry of the Timber and Paper Industry, Ministry of the Food Industry, Ministry of Energy of the Ukrainian SSR, Ministry of Construction Materials of the Ukrainian SSR, Ministry of Light Industry of the Ukrainian SSR, the Fruit and Wine Administration, the Ministry of the Meat and Milk Industry of the Ukrainian SSR, and several others.

As was pointed out, the most notable results with respect to workplace certification and rationalization were achieved at the machine building enterprises (associations), so that in 1984 there were 7000 workers freed up and nearly 13.6 million rubles of primary production assets disengaged. A significant increase in labor productivity was achieved, while the overall economic impact from elimination of the backward work stations amounted to almost 37 percent of the total figure from the entire array of organizational-technical NOP measures (cf. table).

Influence of Workplace Certification and Rationalization on the Technical-Economic Indexes of Ukrainian SSR Machine Building in 1984

(a) Міністерство	(b) Вивільнення працівників у результаті атестації		(c) Приріст продуктивності праці		(d) Економія основних виробничих фондів		(e) Економія плати за основні виробничі фонди, тис. крб.	(f) Економічний ефект за рахунок скорочення (ліквідації) робочих місць	
	чол. (g)	в % до фактичної (h)	крб. (i)	в % до фактичної (h)	тис. крб. (j)	в % до загальної вартості (k)		тис. крб. (j)	в % до загального ефекту від НОП (l)
(m) Усього по 11 міністерствах	6922	0,6	78	0,6	13599	0,1	816	9884	36,8
(n) Мінважмаш	311	0,2	24	0,2	1593	0,1	96	548	22,5
(o) Мінeнергомаш	42	0,2	30	0,2	784	0,2	47	257	42,9
(p) Мінелектротехпром	416	0,2	33	0,2	1281	0,1	77	1448	34,7
(q) Мінхіммаш	229	0,2	29	0,2	788	0,1	47	666	20,7
(r) Мінверстатопром	259	0,2	28	0,2	1208	0,1	72	446	10,4
(s) Мінприлад	354	0,3	33	0,3	668	0,1	40	1975	65,6
(t) Мінавтопром	1398	0,9	122	0,8	647	0,02	39	994	48,2
(u) Мінсільгоспмаш	3198	1,7	278	1,7	755	0,02	45	1965	66,6
(v) Мінтваринмаш	133	0,3	51	0,3	577	0,1	35	281	25,1
(w) Мінбудшляхмаш	19	0,02	5	0,01	5221	0,9	313	620	39,1
(x) Мінлегхарчомаш	563	0,7	72	0,7	77	0,01	5	684	43,5

Key:

a. Ministry
b. Workers released and results of certification
c. Increase in labor productivity
d. Savings of primary production assets
e. Economized payment for primary production assets, thousands of rubles
f. Economic impact from reduction (elimination) of work stations
g. Persons
h. Percent of actual value
i. Rubles
j. Thousands of rubles
k. Percent of total value
l. Percent of total impact of NOP
m. Total of 11 ministries
n. Ministry of heavy machinery
o. Ministry of power machinery
p. Ministry of the electro-technical industry
q. Ministry of chemical machinery
r. Ministry of the machine tool industry
s. Ministry of instruments and appliances
t. Ministry of the automotive industry
u. Ministry of agricultural machinery
v. Ministry of animal raising machinery
w. Ministry of construction and road building machinery
x. Ministry of light and food machinery

The workplace certification program has been most effective at the machine building enterprises of the Dnepropetrovsk oblast. Specifically, as a result of implementation of the corresponding measures in 1980-1983 at the Dnepropetrovsk Combine Plant imeni Voroshilov, more than 800 work stations have been brought up to the level of contemporary requirements and 670 backward stations have been eliminated, in place of which 367 new high-efficiency work stations have been created; the workforce has been reduced by nearly 300 persons. Moreover, in connection with the elimination of backward work stations during the aforementioned period, 2900 m^2 of production space and 649 units of equipment have been disengaged, the sale of which has produced nearly 1 million rubles. As a result of implementation of the mentioned measures in only four years the factory's collective has boosted the volume of production by 31 percent and increased labor productivity by 41.8 percent with a 9.2 percent increase in wages [14]. In the period from 1981 through 1983 the net cost of products was cut by 8 percent, as compared to the 7 percent called for by the plan; income rose by 53.5 percent, compared to 45 percent planned; the specific share of high quality products amounted to 66.8 percent (plan 64.4 percent) [15]. In 1979-1984, the return on assets increased by 10.8 percent at the plant [16]. In 1984-1985, workplace certification at the plant also produced significant achievements: the equipment shift operation ratio was boosted, the level of utilization of production capacities was increased to 96 percent, and the share of products with the State Seal of Quality (DZYa) increased to 80 percent.

The entire increase in volume of production during the 11th Five Year Period was achieved by the plant at the expense of higher labor productivity, the annual mean increase in which was greater than 8 percent. The deliveries of agricultural machinery (beet loading and root gathering machines) were fully carried out in the allotted time, in compliance with the contracts and agreements. Worker turnover was reduced and lost work time minimized [17]. The social activism of the workers increased: over the five year period the number of production workers who voluntarily reviewed the production norms tripled [18].

The experience of a number of other enterprises of the region is also of definite interest. Thus, six months after initiation of serial manufacture of products at the Dnepropetrovsk Machine Building Plant imeni Lenin a certification of the technological processes is being effected. This should reveal the most rational methods of production of parts and assemblies and discover possibilities for utilization of new progressive equipment, high performance tools and attachments, and modern methods of quality assurance in a setting of dynamic multiple-item manufacture. As a result of the work during the 11th Five Year Period, the annual mean rates of increase in labor productivity amounted to 5.5 percent, the manufacture of products with the DZYa exceeded 65 percent of the volume of products subjected to certification, and an economic impact of nearly 5 million rubles was achieved.

The Dnepropetrovsk Metallurgical Equipment Plant (DZMU) is characterized by a customized type of production. The brigade (work team) form of labor organization is common here--more than 85 percent of the workers at the plant

are assembled in 284 brigades. The DZMU is conducting a certification of the brigades for the purpose of determining the actual efficiency of the brigade's manufacturing activity and its potential. In the course of such certification, they are analyzing the available reserves, outlining ways to utilize them, and studying the causes of negative departures from the established assignments, norms, standards and work charts. At present, the plant has progressed from certification of the brigades to certification of the workshops.

It must be pointed out that high efficiency of workplace certification and rationalization measures is generally achieved where they are treated as a continual program for mobilization of the internal production reserves. Thus, at the Production Association "Terminal" (Vinnitsa), a workplace certification program commenced as early as 1980. The main emphasis was placed on taking low-efficiency and obsolete work stations out of service, mechanization and automation of the production processes, and retooling. In 1980-1983 the association introduced 100 industrial robots and other robotlike appliances, 20 ASUTP [automated process control systems] and SAPR [computer-aided design systems]. The labor productivity grew by 25.7 percent, solely due to the increased technical level of production. The number of work stations organized on standard design principles reached 65 percent, the level of use of technically verified norms reached 97.5 percent, and the annual growth in labor productivity from the NOP measures amounted to more than 4 percent. On the whole, introduction of the workplace certification system in the aforementioned period enabled 748 workers to be freed up and the labor productivity to increase by 66.5 percent. In 1984 the "Terminal" association eliminated an additional 125 low-performance work stations during the course of a certification, freed up 215 workers and disengaged 123 pieces of equipment and 780 m^2 of production space [13].

Correlation of the results of workplace certification and rationalization on the territorial level likewise testifies to a significant variability of the change in the basic indexes characterizing their effectiveness. Depending on the level of effectiveness of the workplace certification programs, all oblasts of the republic can be conditionally categorized under three groups.

The most successful in such programs are the Dnepropetrovsk, Zaporozhye, Poltava, Kharkov, Vinnitsa oblasts and the city of Kiev, where 1.1-3.0 times more workers and 1.02-1.75 times more work stations per thousand work stations undergoing certification were disengaged than the average for the republic.

The second group of regions where the specific weight of goods, primary production assets and numbers of industrial workers nearly corresponded to that of the indexes characterizing effectiveness of the workplace certification program includes Donetsk, Kirovograd, Kiev, Ternopol, Chernovtsy, Cherkassy, Odessa and Kherson oblasts.

In other regions of the republic (Voroshilovgrad, Sumskiy, Volynskiy, Zhitomirskiy, Zakarpatskiy, Ivano-Frankovskiy, Lvov, Khmelnitskiy, Chernigov, Crimean and Mikolayevskiy oblasts), the return on time and resources invested

in the workplace certification programs is still slight. In these regions, the workers released were 1.51-2.15 times fewer and the eliminated work stations were 1.4-2.0 times fewer than the figure for the republic as a whole. This indicates a poor level of organizational and methodological work with the certification program in the mentioned regions and the necessity of elaborating and executing a complex of supplementary measures to substantially improve the programs [13].

It must be recognized that heretofore only the most obvious reserves have been tapped during implementation of the workplace certification and rationalization, and the most potent reserves, such as can produce fundamental changes in the organizational and production structure of the enterprises, a savings on labor resources, and a transition to fundamentally new generations of machinery, equipment, and technologies, have not yet been brought into play.

For example, in 1984 there were 515,200 work stations at the investigated enterprises of 11 Union machine building ministries located in the Ukrainian republic, of which 425,400 (82.6 percent) were certified and 89,800 (17.4 percent) not certified, while only 6,000 (1.2 percent) of the noncertified stations were eliminated. Hence, we may conclude that 83 of every 100 work stations fully comply with the prevailing requirements of scientific-technical progress and NOP; around 16 require rationalization and only one work station is eliminated on account of obsolescence and physical deterioration.

But such conclusions as to the level of sophistication of the technical outfitting of the work stations are not entirely correct, since they do not accord with the data of a onetime investigation of the age makeup of the fleet of metalworking equipment, carried out by the statistical agencies in February 1981. In accordance with this, of the total fleet of metal-cutting lathes 55.4 percent had up to 10 years in age (which in the opinion of experts [19] nearly corresponds to the optimal service life of metal-cutting lathes), 31.2 percent were between 10 and 20 years, 9.4 percent between 20 and 30 years, and 4 percent above 30 years. Even on the basis of the 1975-dated depreciation norms, according to which the mean standardized operating period of metal-cutting lathes is approximately 18 years, we must acknowledge that a minimum of 13.4 percent of the lathe work stations in the machine building industry of the republic are clearly obsolete and in need of elimination (and not the 1.2 percent established by the certification program in 1984).

Such discrepancies testify to the inadequate methodology of the workplace certification programs and substantial deficiencies in utilization of the economic mechanism, particularly such elements thereof as payment for assets and distribution of income from sale. In accordance with the regulations in force for more than 20 years (since 1965), payment for obsolete and depreciated facilities at the disposal of an enterprise is made from the available surplus income, which appears as such in the budget. Practically speaking, the keeping of machinery whose service life exceeds the standard has almost no effect on the basic technical-economic indexes of the enterprises or associations and does not influence the size of their economic incentive funds.

Therefore, it is necessary to encourage the removal from service of obsolete and physically depreciated primary production assets and close down backward work stations. It should be pointed out that the material (particularly, the financial) preconditions for this already exist in the form of the depreciation deductions. Unfortunately, to the present day these deductions are not being fully utilized. Thus, in 1984 the depreciation norm for complete replacement of production assets of industry as a whole was approximately 3.5 percent, of which 4.0 percent went to machinery and equipment, which corresponded to a standard service life of 30 and 25 years for these facilities; but in fact the removal from service amounted to 1.4 and 2.5 percent of the figure at the commencement of the year. Approximately the same relationship is characteristic of machine building and metalworking in the republic.

It is necessary to stress the difficulties involved in the methodology of work site certification at the enterprises. The industrial enterprises of the republic employ for this purpose the "methodological recommendations..." [11], ratified by the Ukrainian SSR State Work Commission and approved by the coordinating committee of the republic's comprehensive scientific-technical target program "Work" in 1983. At the same time, these recommendations are essentially geared to organization of the workplace certification program of the machine building enterprises (associations). For the time being, creation of a unified methodological foundation for widespread certification and rationalization of work stations in other branches of industry and the economy is proceeding slowly.

Thus, utilization of the potentialities of workplace certification and rationalization in the machine building industry of the Ukrainian SSR is still far from complete. In order to expand the scale and boost the economic effectiveness of workplace certification and transform it into a permanent factor of acceleration of the scientific-technical, organizational, and socioeconomic progress, in our opinion the following steps should be taken:

1. Assure a close connection between the workplace certification programs and the economic organizational measures to expand economic self-sufficiency and strengthen the responsibility of the associations and enterprises; in particular:

- in the case of workplace certification and rationalization, concentrate on upgrading the organizational-technical level of each work station, increasing the workload and the shift operation ratio of machinery and equipment, rational utilization of the workforce, and prevention of unwarranted creation of additional work stations when those already present are underutilized;

- a well orchestrated certification program with the direct participation of the foremost workers and innovators and the production brigade members, cooperating with scientific research and design development organizations, scientific-technical societies, inventors and rationalizers [efficiency experts];

- implement the certification program in an atmosphere of publicity, using it to create a resource-husbanding attitude among the workers, technicians and employees toward the production process and a sense of responsibility for their work station.

2. Strengthen the planning foundation in the organization of the workplace certification programs. The workplace certification measures should be included in the technological and financial plan of the enterprises and the contract of the collectives.

3. Implement a gradual transition from certification of the individual work stations to certification of the sections, workshops, production processes and enterprises as a whole. This will allow the development of a well grounded program of workplace modernization, removal of the backward segments from service, and concentration of the work resources on the more productive equipment.

4. Combine the fundamental ideas and propositions of workplace certification and rationalization with the Shchokinskiy method of production intensification and labor productivity increase. This could greatly enlarge the volume of production with a lower number of workers through the development and adoption of progressive labor norms, unification of related professions and enlargement of the machine attendance zones, improvement in the structure of management and centralization of factory facilities, thereby assuring a significant economic and social effectiveness.

5. Improve the organization of the programs selling off obsolete equipment as determined during the workplace certification.

6. Synchronize (wherever possible) the workplace certification program with the quality certification program of industrial products.

7. Carry out (in the workplace certification process) a mandatory examination of the quality indexes (structure, years of service, down time factor and coefficient of introduction) of the fleet of metalworking equipment and supplementation of the prevailing procedural recommendations [11] with a special clause regarding the allowable intervals of service of the machinery and equipment in use at the enterprise.

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INDUSTRY PLANNING AND ECONOMICS

ACADEMICIAN FROLOV: MACHINE-BUILDING CATALYST OF PROGRESS

Moscow PRAVDA in Russian 23 Jun 86 pp 1-2

[Article by M. Vasin: "Machine Reliability: Machine Building--Catalyst of Progress"]

[Text] The MNTK [intersectorial scientific and technical complexes] which are now being formed in the country are a new type of a union of science with production. They are intended to speed up our advance on the main routes of scientific and technical progress. The complex "Machine Reliability" is being created under the aegis of the USSR Academy of Sciences. This indicates what major importance the staff of Soviet scientists attaches to increasing the reliability of modern equipment.

Situation

There are problems in machine building which are classified as "eternal." One of these is the problem of the reliability of machines, parts, and structures. At each turn in equipment development it crops up in a new form, announces itself far more urgent than before, and requires all the greater efforts and expenditures to solve it. This is understandable: the breaking of the wheel of a cart harnessed to oxen, of a motor vehicle, and an airplane coming in for a landing--these differ in their consequences.

The reliability problem has become especially sharp in the era of the NTR [scientific and technical revolution]. The latest equipment all the more convincingly corroborates the well-known rule--the more complicated the machine, the higher probability of its breakdown. Specialists are already seeing phantom machines in the future--unprecedented in their theoretical possibilities, wonderful in design, and absolutely unable to work: they have exceeded the limits of permissible complexity.

However, these are, so to speak, imaginary visions. Meanwhile, today's reality makes one think seriously. Here is an impressive example given by the vice president of the USSR Academy of Sciences, academician K. V. Frolov:

"Automated equipment is intended to make up for the labor shortage. Modern production has become saturated with the most complex machines and units which, naturally, require additional labor expenditures for repair and maintenance. In the future these expenditures, if equipment reliability and durability remain at the present level, will grow even greater. As a result, we will not be able to realize any savings in human resources: the work force will simply be transferred from the production area to the maintenance and repair sphere."

To avoid this and to drive the phantom machines out of sight, it is necessary to develop new approaches to the old problem of reliability--both in its scientific and its practical aspects.

However, the urgency of the reliability problem has intensified sharply not only for the latest machines but also for the ordinary ones remaining from the past. With an increase in the tempo of production, loads are also unavoidably growing on the equipment, so to speak, of the pre-NTR model. Besides that, an additional burden of responsibility has fallen on it: for you see, machines only in rare cases operate like Kipling's cat that worked by itself; more often they play the role only of elements in a complex technical or production system operating at a modern high-speed rhythm, and their breakdown nearly always involves the stoppage of this entire expensive "supermachine."

As a result, during the period of planned operation, the expenditures to maintain and repair some machines exceed by several times the cost of manufacturing them. The replacement of worn-out parts alone, according to data of corresponding member of the USSR Academy of Sciences P. N. Belyanin, costs our country about 12 billion rubles a year. And this is along with the fact that the reliability indicators for the most complex and crucial equipment produced by advanced sectors have been significantly improved: as the academician G. P. Svishchev writes, aircraft engines have a service life of up to 20,000 hours, civil aviation airplanes and large-scale technological complexes--up to 20 years, and thermal power plants--up to 40 years.

Paths

Thus, the task is to sharply increase (understandably within the framework of economic and engineering expediency) the reliability both of single-design, especially complicated equipment as well as mass machine building production.

"It is impossible to achieve this goal without the energetic assistance of science," the academician K. V. Frolov maintains. Therefore, in the USSR Academy of Sciences a department on the problems of machine building, mechanics, and control processes was recently created, new research institutes are being organized, the MNTK "Machine Reliability" is being formed and searches are being carried out for other types of close interaction with the sector NII's/scientific research institutes/, KB's/design bureaus/, and scientific production associations. The USSR Council of Ministers' Machine Building Buro has prepared, jointly with the Academy of Sciences, a program of long-range basic research. Great efforts and preparation for reorganizing work are also required of the machine building enterprises. Reliability is being lost at various levels.

The most accessible level is labor and technological discipline. For example, careless welding--this starts as defects in structures and threatens to put diesel locomotives, railroad cars, motor vehicles, tractors, and combines out of operation. Some products are made with deviations from GOST/All-Union State Standard/ requirements, and from design and technological documentation. Here we see the effect of the many years of pursuing quantity over quality, economy not in an intelligent way, but for show--much more material is then expended on spare parts and repair than is saved during manufacture. These obstacles in the way of increasing reliability will be eliminated as the result of the implementation of the measures set by the 27th CPSU Congress--bringing order into production, increasing the material motivation and responsibility of workers, reorganizing the economic mechanism.

The second layer of the problem is an obsolete or maybe semi-primitive production technology. This happens often--it results from the desire of the enterprises not to depend on a supplier, to have everything their way. The output of unreliable hydraulic and pneumatic units, brakes and seals, sliding bearings, fuel equipment, brackets--a gift to the natural economy. The size of this gift will be decreased by deepening production specialization and increasing the responsibility of the suppliers which is also accomplished in accordance with party decisions.

However, even with a well-organized production it is impossible to get the output of dependable and durable modern equipment going if its creators do not have a proper experimental and computer facility, it is impossible to provide the reliable operation of the manufactured machines if the operators do not have effective diagnostic means at their disposal. Right here is one of the main areas to concentrate the efforts of scientists.

Strategy

The reliability of a unit, machine, machine tool is established during their design. How is this task accomplished in usual practice?

With the help of manuals, experience, and his own awareness, the designer develops the parts, units and entire machine as a whole and works up the design; then they manufacture a model of the new item (several would be better) and its testing and experimental operation begin; design deficiencies are gradually discovered, statistical material is accumulated on increased parts wear and machine breakdowns. The designer makes the appropriate changes to the plan, the plant produces a small series of items, and their operation and statistical data collection begin again. Often this cycle is repeated several times so that a properly finished machine appears after 5-6 or more years. It happens that a machine may have time to become obsolete during this period.

Therefore, a number of advanced sectors are now obtaining information on reliability up to the beginning of operation of the created equipment--with the help of physics and mechanics, complex calculations, the latest modeling and forecasting methods, and with the help of the study of test models on stands and at test stations, where it is possible to produce the entire spectrum of future loads.

A similar approach must also be taken in other sectors on a broad scale. Consequently, it is necessary to develop appropriate methods and techniques and create testing and diagnostic equipment operating interdependently with computer equipment. Much of this has already been done in the Institute of Machine Building imeni Blagonravov of the USSR Academy of Sciences, in TsAGI /Central Institute of Aerohydrodynamics imeni N. Ye. Zhukovskiy/, MVTU/Moscow Higher Technical School imeni N. E. Bauman/, TsNII/Central Scientific Research Institute/ imeni Krylov, the NPO/scientific industrial association/ TsNIITMASH/Central Scientific Research Institute of Heavy Machinery/, the Institute of Electric Welding of the UkSSR Academy of Sciences, and at other scientific centers.

According to modern ideas, the designer must not adapt himself to materials which industry has already produced but "design" them for specific purposes. There is a great scientific reserve in this area.

Take composites--polymer materials reinforced in strictly fixed directions with fibers (made of glass, carbon, boron, etc.). The firmness and hardness of a part made of such material can be several times greater than metal. It is proposed with good reason to make even springs and universal joint shafts for motor vehicles, crucial structures for robots and other equipment from composites--their weight is often cut in half and durability increases.

The use of modern design methods, the use of effective materials and technologies--this is one of the facets of the deep-seated problem of reliability. There is also another that is no less important. The durability and efficiency of a machine, which are established in the plan, must be provided during its manufacture and maintained in operation. Therefore, a question now comes to the forefront: is the manufacturer capable of seeing clearly, of fixing the sizes of the parts, the condition of the machined surface, the residual stresses, and the operator--have damages, e.g., the formation of microfractures, accumulated in the material? Complex measuring, testing and control equipment and diagnostic means are quite often necessary for this under modern requirements and tolerances. At the manufacturing stage sensors must be implanted in the organs of the most crucial machine units which will keep track of the state of "health" of the mechanical worker and transmit signals to appropriate instruments. This will permit the operation of equipment under the most favorable conditions, the elimination of accidents, and repair work not according to a plan as now, but according to its true condition.

Serious research is being carried out in this area.

It is necessary to speak separately about the scientific project to solve the reliability problem. Models of equipment, structures, units, materials intended to provide durability and reliability to machine building production--about 200 developments of the country's academic and sectorial institutions, were recently assembled at the Institute of Machine Building of the USSR Academy of Sciences. Testing complexes, friction machines, measuring robots, a whole spectrum of various sensors, technological installations for laser hardening and other machining of parts, bearings made of metallic polyfluoroethylene resin, operating in an enormous temperature range, units with gas lubrication, and anti-vibration metallastics--laminated designs made of metal and rubber, were presented here.

A great number of these "exhibits" are awaiting their turn for mass introduction. It is not known how long they must still wait.

A change is necessary--in design methods, in plant technology, in operation, in providing all of these units with the "reliability tool"--modern sensors, instruments and installations for control, testing, and diagnostics of machine building production.

Plan for a Change

This plan is called the MNTK "Machine Reliability." It was developed by the USSR Academy of Sciences and the GKNT/State Committee of the USSR Council of Ministers for Science and Technology/. The head organization of the complex is the Institute of Machine Science.

The basic idea is as follows.

The MNTK "Machine Reliability" must be constructed in a way that will bring the scientists of the academy and intersectorial scientific organizations closer to production--to its requirements and needs, to assist the design bureaus and enterprises in training personnel, assimilate available innovations, improve technology, and fix the series output of the reliability "tool" which is necessary for all machine building sectors.

There is sufficient work for production workers for several years. During this time the scientists will bring other of their own developments up to an "introductory condition" and will push exploratory, basic research forward. Thanks to improvement in the economy and control mechanism, a scientific production conveyor, which will exert significant influence on the level of machine building in the country, will be created within the framework of the complex.

The structure of the complex has also been determined in accordance with this idea. (However, it must be flexible and change depending on the tasks which emerge). Academic institutions make up its nucleus: the Institute of Machine Science and its branches, the Institute of Metal Superplasticity, and the TsKB /central design bureau/ of Special Purpose Instrument Building. In addition, sectorial organizations and enterprises will participate in the complex. Among them are the NPO's Spektr and Burevestnik, the Central Boiler and Turbine Institute, the plants Vibropribor, Tenzopribor, and the PO/production association/ Tochmashpribor. Finally, the plan calls for attracting a number of other NII's, enterprises, and VUZ's/higher educational institutions/ to this collaborative effort. That is to say, the intention is for all units to train personnel, "make" science, bring developments up to a series suitability level, and output products which are extremely necessary for machine builders and operators.

The complex will also play a prominent role in fulfilling the all-union scientific and technical program "Reliability" (its formation is now being completed). The task before us is to develop a system of GOST's, methodological directives and recommendations, quality indicators--everything that in many respects controls machine building production reliability indicators which are not now controlled and helps the sectors to use the latest methods, equipment, and materials.

When to Go on a Reconnaissance

The range and significance of the planned work are obvious. The complex's structure has been basically thought out. Nevertheless, when you talk with scientists who are participating in its formation, you experience some uncertainty and confusion. It turns out that even though it is now time to begin work, it is impossible to start. The important legal document is still lacking--the regulation on the MNTK has not been approved. They have been waiting for it for a long time. A total flood of paper concerning the complex has sprung up and is growing--requirements, plans, refinements. It seems that this business is beginning to spin its wheels in paper.

All of the participants in the future collective, according to the impressions of the deputy director for scientific work of the Institute of Machine Science, professor A. P. Gusenkov, warmly support the idea of establishing the MNTK. However, it turns out that the plans of the enterprises belonging to the complex have already been set and, so that the plants can energetically start assimilating new things, the ministries and USSR Gosplan/State Planning Committee/ ought to free these enterprises from a portion of their tasks and to think about creating some production at them. Other questions also arise. Will the uninterrupted supply of full orders of very scarce items be set up? Are the influence levers at the plants--MNTK funds for motivating workers and developing the enterprises--sufficient? Difficulties of a legal nature are also being displayed...

We will look the truth in the face: it is impossible to foresee, when creating the complex on paper, all of the complexities and sharp angles in the activities of a completely new organization, which is not a usual thing for either scientists or production personnel. However beautifully written the regulations and instructions may be, you cannot cram real experience within this framework; corrections and refinements are necessary. Kolkhozes, sovkhozes, and plants are being granted great independence and freedom of maneuver today. One must think that the MNTK will have the same rights at its disposal. However, why not give the complex managers--prominent scientific organizers and competent scientists--the right to maneuver and to make responsible decisions at the stage of organizing and adjusting the activities of the MNTK under realistic and rather specific conditions? The creation of a new form for uniting science with production has as its purpose the achievement not of the uniformity of its introduction mechanism but of its effectiveness.

"To lose time now on a detailed study of the organizing forms for the entire vital activity of the MNTK does not make sense--a reconnaissance in force is required--" the academician K. V. Frolov said in discussing this "hitch at the start."

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INDUSTRY PLANNING AND ECONOMICS

ULTRASOUND MACHINE TOOL ASSIMILATION, PROBLEMS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Jul 86 p 2

[Article by special SOTSIALISTICHESKAYA INDUSTRIYA correspondent V. Lifanov, Saratov-Moscow: "How Many 'Cooks' for the Ultrasound 'Broth'," "Technical Progress: Ways to Accelerate the Pace"]

[Text] At one of the plants in Saratov I saw machines which were drilling, countersinking and broaching very small holes. What was surprising was that these delicate instruments, no more than a millimeter in diameter, would bite into the stainless steel and titanium alloys just as though there were no danger that they would break, burn up or become dull.

It was ultrasound vibration which gave them this "confidence in themselves." Supplied from a generator by way of a piezoceramic converter, they reduced the force of the cutting and the friction, improved the process of removing the cuttings and helped the cutting fluid cool and lubricate the tool better. This was achieving a two- to three-fold increase in the durability of the tool as well.

"It's a pleasure pure and simple to run one of these machines," the drill operators told me. "They increase labor productivity and greatly reduce consumption of hard-to-get tools."

It is a generally known fact that ultrasound offers an extraordinarily broad range of potential applications. Focusing energy on a comparatively small part of the working area, the high-intensity, high-frequency elastic waves produce effects which under natural conditions would simply be impossible. "We do not know today of any other medium which is so variable and produce such effects on physical and chemical processes," say scientists.

An all-Union conference on science and technology met in Saratov last year, which heard presentations on the latest important advances in the development of ultrasound equipment and in ultrasound engineering generally and which heard some new names mentioned. In his opening remarks, Professor A. Markov, chairman of the conference organizing committee, underlined the fact that as far as the level of development of the physical bases underlying the application of high-power ultrasound in industry, Soviet science is now number one in the world.

So it was all the more surprising to learn that the other side of the coin, that is, the practical side, is not nearly as bright. As was pointed out at the conference, most of the positive results in this areas have been achieved only in laboratory experiments or under industrial test conditions. This is to say that a yawning gap has opened up between theory and practice.

The thinking was that the scientists and production engineers gathered here would undertake a principled, straightforward analysis of this highly abnormal situation, uncover the problems which are placing obstacles in the way of the introduction of this new technology and point to things which can be done to solve them. This, however, was not the case. The organizers of the meetings, the scientific and technical society of the machine-building industry and the USSR Academy of Sciences' science council on ultrasound, conducted their discussions in a particularly scientific key. They made a deliberate effort to avoid discussion of the shortcomings here, and if they did say anything about them it was only in the nature of some superficial remark, some generalization, nothing specific, to the point. So it came as no surprise that the recommendations issuing from the conference resembled more a petition than a document which would force itself on the attentions of those to whom it was intended.

The more I study the problem of the introduction of high-power ultrasound in industrial manufacturing operations, the more obvious it becomes that the relationship many researchers and developers in the field of ultrasound technology now have with industry suits them just fine. It is all so convenient, to be able to sit in the quiet of your laboratory and know that when you leave there will be a monograph or a dissertation, that the State Committee on Inventions will write you out an inventors certificate and that somewhere somebody is going to get you an award. And as far as any practical results are concerned, well you can let your mystery "uncle" worry about that.

"Of course," Doctor of Technical Sciences O. Abramov, who represents the USSR Academy of Sciences' Institute of Solid State Physics, will say candidly, "we would all like to see the fruits of our labors. But not all of us wants to have to make the rounds of all the administration offices and demonstrate this and that and try to convince people of one thing and another, to have to encounter nothing but cold indifference, red tape, procrastination and sheer ignorance. I went through the routine one time myself—and was sorry for it. The head of the ministry of the electrical equipment industry's former Soyuzelektroterm all-Union industrial association, V. Lugovskiy, quite simply read the riot act to subordinates who were presenting some soundly reasoned arguments for setting up to manufacture ultrasound equipment at the Elektrosvarka works in Kaliningrad."

Oleg Vladimirovich was recalling this incident in connection with the initiative a group of Moscow scientists had undertaken. They had studied numerous requests and wishes which had been expressed by people in a number of places and had outlined a draft program calling for the practical introduction of ultrasound technology during the current five-year-plan period. The draft promised, among other things, that implementation of this program would free up some 160,000 workers from production operations, save 250,000 tons of ferrous and 2000 tons of nonferrous metals, 350,000 tons of chemical raw materials, 13 million kWh of electricity etc.

But before this program could be "granted its citizenship" and instructions issued for its implementation, the draft had first to be coordinated with all the ministries and agencies having anything to do with the introduction of ultrasound technology. But it was precisely at this point that the whole project ran into a dead end. As soon as the problem of coordination arose, the scientists who had launched this initiative had to consider the whole business at an end.

Incidentally, I would mention parenthetically that the visit O. Abramov and his colleagues paid to the Soyuzelektroterm all-Union industrial association was not, ultimately, without its results, and arrangments are now under way in Kaliningrad to manufacture the required equipment. So we probably don't need to be too pessimistic about what can come from personal contacts between scientists and production people.

In Moscow alone there are now more than ten scientific organizations at work on the problem of putting high-intensity ultrasound to practical use. But they are all proceeding in a splendid isolation from one another. So one of them is always short of something, each one has its own problems. The most serious difficulty consists in the fact that research does not lead to design studies. There is not a single design office in the capital which would design and develop industrial ultrasound equipment. This is the reason, for example, that the problem of matching the series-produced generators with the irradiation set-up. The There is a serious shortage of converters and most of all of the wave-guide radiation systems for them, the varieties of diaphragms, rods, ring assemblies etc.

Interindustry, and here we are referring specifically to ultrasound, technology is split up among a number of departments and agencies. But too many cooks, as we know, can spoil the broth. It has long since been time, in the view of the ultrasound researchers, to set up a central organization which would be directly responsible for the application of ultrasound in industry. By bringing the now scattered efforts under a single wing, it would be able to coordinate and give some direction to the scientific effort; it would be directly linked to the ministries and production facilities involved in the manufacture and application of ultrasound technology and dictate to them the technology policy best suited to the needs of the economy.

But things have yet to get beyond the talking stage. The USSR Academy of Sciences' scientific council on ultrasound technology would probably have some important things to say about any effort to consolidate the efforts is this field. The problem here, though, is that is has been four years now since the council has had a chairman and there'e nobody to do anything really concrete about this particular problem....

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INDUSTRY PLANNING AND ECONOMICS

MACHINE-BUILDING MODERNIZATION SEEN KEY TO IMPROVING INDUSTRY

Moscow STROITELNAYA GAZETA in Russian 16 Jul 86 p 2

[Unattributed article: "A Facility Starts With A Plan"]

[Excerpts] Builders have difficult and important problems ahead of them in the 12th Five-Year Plan. The total sum of capital investments for 1986-1990 will reach gigantic proportions: 994 billion rubles. The number of projects to be handled by collectives in the construction ministries will grow noticeably. For the USSR Ministry of Heavy Construction this growth will be 25 percent; and for the Ministry of Industrial Construction and the Ministry of Construction it will be 30 percent. Plans envision increasing the productivity of labor within the industry by 24 percent.

This year, the ministries are building and overhauling almost 200 enterprises and facilities. And in 1987, another 150 will be built. Thus, the first two years of the 12th Five-Year Plan will see one-third of those of the construction industry's capacities specified in the above resolution overhauled.

It is clear that the plan to modernize the nation's productive apparatus, including the construction infrastructure, using the latest scientific and technical developments depends ultimately on the strength of the machine building industry. This is why it is more important for the USSR Ministry of Construction, Highway, and Communal Machine Building than any of the other ministries prompted to action by the above-mentioned resolution to perform all the tasks it has been assigned within the time limits specified.

In previous years, this ministry has dealt primarily with modernizing already existing equipment. Now, however, this equipment is no longer up to current scientific and technical standards. Hence, the resolution states that USSR facilities must organize and begin mass production of the following: state-of-the-art manufacturing equipment and fourteen production lines capable of manufacturing completed units. In addition, factories will have to begin producing equipment equivalent to the best manufactured outside the USSR.

Enterprises producing construction materials or involved in the construction industry and the design institutes of the various branches of industry are depending heavily on the Ministry of Construction, Highway, and Communal Machine Building to speed up development of new high-output equipment.

In addition, some planning estimates have not been up to standards. The USSR Gosstroy's Glavgosekspertiz [Main State Expert Examination Office], which has checked a number of plans, found that the one for the Pervouralsk Tubular Structure Plant, which was prepared by TsNII Proyektstalkonstruktsiya [Central Research and Development Facility for Planning Steel Structures] (Director V. Kiznetsov) and approved by the USSR Ministry of Installation and Special Construction Projects, had the following problems. Neither the plan itself nor the ministry's conclusion to it contained what was most important; that is, information on the degree to which the techniques, equipment, and way of organizing labor they had decided on were in line with the latest domestic and foreign developments in science and technology. In addition, no mention was made of the quality of what was to be produced or how up-to-date it would be.

It is no surprise that this information was missing. Indeed, the plan dealt primarily with the production of obsolete and inefficient structures (girders, trusses, couplings) and industrial buildings made of round pipe. This in turn means that engineers were unable to use highly mechanized and automated tubular structure production lines. In addition, producing in this way uses twice the amount of labor that would be needed to make rectangular pipe. The USSR Gosstroy's Gosekspertiza has instructed one of the TsNII Proyektstalkonstruktsiya's subordinate agencies to develop a plan for a plant incorporating up-to-date technology, computerized equipment, automated production lines, and robot complexes that would enable productivity at a given enterprise to at least double.

In another case, the plan for the Sorsk Silicate Wall Construction Materials Plant prepared by Sibgiprostrom [Siberia Plaster Construction Agency of the RSFSR] (V. Rubtsov, director) and approved by the USSR Ministry of Construction Materials incorporates a very low level of automated and mechanized production. This level is insufficient to permit the plant to be ranked among those which can be considered up-to-date, and it is clear that the plan needs to be reworked.

We could continue with the list of these kinds of errors on the part of planners. Such a list would also be evidence that ministerial expert examination organs are not looking at planning estimates with the proper degree of integrity and scrupulousness.

Considering the great importance of the problem, we need to rectify the situation as soon as possible. Ministries and design organizations must do everything they can to have the technical documentation for projects scheduled for 1987 ready no later than October of this year. Moreover, they must insure that such documentation is properly prepared.

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INDUSTRY PLANNING AND ECONOMICS

APPROACHES TO CUT MACHINE-BUILDING INDUSTRY METAL CONSUMPTION

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 86 pp 38-45

[Article by USSR Gosplan deputy department chief A. Zaytsev: "Setting Norms for Metal Usage in Machine Building"; material in all capital letters is in boldface type in original]

[Text] Ways of eliminating shortcomings in the consumption of metal products * Reshaping operations for economizing metal resources * Improving norm setting and the distribution of metal articles * The role of planning in efficient metals usage.

Machine building is the principal consumer of ferrous and non-ferrous metals. The products of the sector, the product range of which exceeds 100,000 aggregated product types, are machinery, equipment and other types of technical equipment which consist chiefly of metal. Improving its utilization of metal was therefore always a most important task for machine building, as well as a means of raising the efficiency of production in this sector of industry and in the national economy overall. The improvement of metal-resource consumption as a dedicated task consists not only of reducing its volume per unit of machine-building product, but also of creating machinery and equipment that allows the consumer to obtain the maximum useful effect per unit of metal consumption expended on their reproduction.

Much attention is devoted to raising the efficiency of metals utilization in machine building. The search for ways of solving this problem, however, has been conducted basically in the sphere of setting norms for its consumption per unit of product. It was felt that a reduction in the process norms for consumption for specific types of machinery and equipment and their continuous tightening was the chief method of effecting an improvement in metals utilization. This was identified with an increase in the efficiency of their application.

Over a long period (1965-85), the tools for planning influence on improving metals utilization in machine building were the targets for average reduction in the consumption norms, which were established in the plans for economic and social development by ministry, department and union republic and sent to associations and enterprises. Outwardly, this influence had good results.

Although these targets for the principal structural material--rolled ferrous metal--were 80-85 percent fulfilled for machine building overall in the 9th, 10th and 11th Five-Year Plans, the reduction in the consumption norms in this period nonetheless turned out to be impressive and was estimated to be on the order of 38 percent. And if this reduction, judged by the reports, were the only criterion for the efficiency of metals utilization, then the conclusion could be drawn that the problem has been solved.

Unfortunately, however, that is not the case. The design mass of the majority of the machinery is not being reduced in practice, and is growing for many types, which is not accompanied by a rapid increase in their productivity and reliability. This makes it necessary to increase the output of machinery constantly and, correspondingly, to increase metals consumption. As a result, the "problem" of a metals shortage has appeared and difficulties in meeting the need for it in this and other sectors of industry and the national economy have grown more acute.

With the aim of strengthening the influence of the plan on raising the efficiency of metal-products consumption, the composition of the indicators of the economy and rational utilization of ferrous and non-ferrous metals in machine building was expanded considerably (especially in the 11th Five-Year Plan). CURRENTLY APPROVED IN THE STATE PLAN FOR ECONOMIC AND SOCIAL DEVELOPMENT ARE: TARGETS FOR THE AVERAGE REDUCTION IN THE CONSUMPTION NORMS FOR 26 TYPES OF METAL PRODUCTS AND THEIR UTILIZATION FACTORS, AS WELL AS FOR ROLLED FERROUS METAL AND INDIVIDUAL NORMS FOR THE CONSUMPTION OF FERROUS AND NON-FERROUS METALS FOR METAL-INTENSIVE TYPES OF MACHINE-BUILDING PRODUCTS. For example, there are 30 targets approved for Minavtoprom [Ministry of the Automotive Industry] for metals economy, not including the individual consumption norms.

This whole cumbersome system of indicators is directed only toward reducing the process norms of consumption. A SUBSTANTIAL IMPROVEMENT IN THE UTILIZATION OF METALS PRODUCTS, HOWEVER, HAS NOT BEEN ACHIEVED. What is going on? I think that it is as follows.

FIRST, practical conclusions were not drawn from the fact that process (plant) norms for metals consumption should be regarded to a large extent as a consequence, and not a cause, of this or that utilization of it per product unit. Of course, the norms should be progressive; that is, reflect their planned reduction through organizational and technical measures for improving the equipment, processes and organization of production. But if the conditions are not created for this, a reduction in the consumption norm should not be counted on.

In reality, its substantial reduction cannot be expected when products are often produced for 10-15 and more years with a practically unchanged design execution, the technology of metalworking is being improved insignificantly (especially in blanks production), the pattern of structural materials and first and foremost in the area of progressive materials employed (light metals and alloys, plastics etc.) hardly changes at all and the tasks of reducing metal intensiveness in design and decreasing metal waste are not placed before machinery and equipment developers. Under these conditions, the "fulfillment"

of the targets for reducing consumption norms is practicable basically by way of raising them too high, especially for new products, with their subsequent reduction in accordance with the established targets. Much documentation can be produced for examples of the over-setting of norms, and first and foremost group ones, versus the given technical documentation and actual consumption.

SECOND, when everything or almost everything is planned from above, the ministries and chiefly the enterprises have little opportunity to have an active influence on the efficient utilization of resources. Thus, the dozens of targets for reducing the consumption norms and the other indicators of metals economy cited above practically completely regulate the process uses of metal products at the plants. They thereby leave no possibilities for the maneuvering of resources and the selection of the most optimal ways of economizing this or that type of ferrous or non-ferrous metal under specific conditions, and they restrain independence in conducting a resource-conserving policy.

EXTREMELY DETAILED AND EXCESSIVELY NUMEROUS TARGETS ESTABLISHED IN THE PLAN FOR METALS ECONOMY DUPLICATE OR CONTRADICT EACH OTHER TO A GREAT EXTENT. Hence it becomes obvious that the organization of their development, delivery for execution and fulfillment cause considerable difficulty, accompanied by an unwieldly and unjustified reporting and controls system.

Rigid planning from above of the product range of the articles produced does not allow the task of raising the efficiency of metals use to be made the starting point in the planning of product output. This is aggravated by the absence of special tasks for its renewal, the actual level of which is inadequate.

The experience of the GDR confirms the decisive significance of the purposeful improvement of the structure and mix of product output in raising its quality and reducing material-resource consumption per unit of useful effect or end result. Product renewal is a state task there and is envisaged as being on the scale of 30 percent a year, and 40 percent for consumer goods; that is, over a five-year plan, industrial products should be renewed 1.5-2 times. This facilitates efficiency in the pattern of production and export so that the scientific and technical level of the products corresponds to the highest modern requirements, as well a noteworthy improvement in the correlation between expenditures and results through the continuous improvement of product quality.

THIRD, it is impossible to count on a radical turnaround in the economical and rational use of metal if the management of this process is not placed on a clear organizational foundation. Such management has not yet been created. Departments (groups) for materials standards, formed at one time at ministries and enterprises with the aim of introducing order in the setting of norms for the consumption of raw and other materials and basically fulfilling those functions, cannot take upon themselves the task of increasing the efficiency of metals use. The factors that determine the nature of its consumption, after all, are a result of the work of practically all the subdivisions and services of enterprises and ministries, and first of all the technical and economic-planning ones.

But up to now even the development of plans for economizing and reducing the norms for metals consumption at enterprises has been entrusted to the material-standards departments. The designers and process engineers, without special targets for limiting the mass of machinery and the amount of metal waste, participate poorly in the formulation of plans for economizing. No one has determined their responsibilities in this matter. As a result, the targets delivered to the enterprises for the reduction of consumption norms are often not provided for by developed measures; that is, their fulfillment is not reliably reinforced.

Finally, FOURTH, without directed incentives for economizing metal, one cannot hope that this work will be developed as needed. The material-incentives fund, serving today as the principal impetus for the results of economic activity, is formed by the "common-pot" method. It is therefore difficult to use it to make note of specific workers for economizing metals. The question not of how much machinery is manufactured, but what is produced and at what price with what expenditures, is moving to the forefront in the 12th Five-Year Plan. It is becoming a fundamental premise in the planning of machine building.

The Fundamental Areas of Economic and Social Development of the USSR for 1986-90 and for the Period to the Year 2000 is oriented toward raising the efficiency of metals use in the sector. Projected in the current five-year plan is a proportionate reduction of 12-18 percent in the metals consumption of machinery and equipment along with a 27-29 percent average reduction in the consumption of rolled ferrous metals (per 1 million rubles of commodity output), 20-22 percent in steel tubing and 21-23 percent in non-ferrous metals.

Also projected in the 12th Five-Year Plan is the implementation of a series of measures for improving the technology of production, expanding the use of progressive basic technologies by 1.5-2 times, ensuring the widespread incorporation of fundamentally new technological processes that raise labor productivity by many times, raising the efficiency of resource utilization and reducing the power and materials consumption of production. Proceeding from the tasks of creating progressive new equipment and realizing the resource-conserving trends, the pattern and quality of structural materials will be improved. Specifically projected is providing for the production of no less than 50 million tons of rolled sheet, 20-21 million tons of rolled low-alloy steel and 15-16 tons with hardening treatments.

The supply of efficient types of structural materials for machine building will be increased considerably: low-alloy steel and thermally hardened rolled metal by 2.2 times, sheet steel in rolls by 2.3 times, die-rolled sections by 1.7 times, roll-formed steel sections and shapes of high precision by 1.4 times, powdered iron by 2.6 times etc.

Organizational measures for the accomplishment of tasks in economic intensification, including in the sphere of the utilization of metal resources, have also been determined. Improving the system of planning indicators, strengthening their orientation toward final economic results and

increasing the significance of indicators that reflect the efficiency of the return on labor, material and financial resources and the quality and scope of product renewal has been deemed essential. The management system, as emphasized in the Fundamental Areas, should be directed toward a decisive transition to the utilization of intensive development factors, the acceleration of scientific and technical progress and the fuller satisfaction of public needs.

The efforts of the centralized organs of economic management are concentrated on resolving the most important problems of social and economic development, improving national-economic proportions and realizing key scientific and technical tasks. The role of the principal production link--the NPOs [scientific production associations] and enterprises--should be increased, and their economic independence expanded along with opportunities for technical retooling and improving production and planning with the concurrent raising of responsibility for the end results of operations and the better utilization of all types of resources.

All of these requirements and directives relate to the fullest to machine building. The tasks of raising the efficiency of metals use in the 12th Five-Year Plan and in the future require a reshaping of operations for the conservation of metal resources.

All spheres of planning and economic activity should proceed from the fact that product output in the sector should increase with practically no increase in the supply of metal. The supply of rolled ferrous-metal resources for machine building is projected to increase on the order of 1 percent. Consequently, the accustomed view of increasing equipment output through the inclusion of an additional amount of rolled metal will have to be dispensed with. The discussion concerns not only the fact that familiar machinery will be manufactured from a smaller quantity of metal, but that the new ones should also require less consumption and be more reliable and productive. Experience exists in operations on expanding the output of articles without an increase in material resources. Thus, Minelektrotekhprom [Ministry of the Electrical Equipment Industry] increased the amount of product output in the 11th Five-Year Plan with practically unchanged consumption of rolled ferrous metal.

Some economic managers have a skeptical attitude toward the indicators for metal consumption per 1 million rubles of commodity output and the targets for its reduction. They feel that these are conditional or estimated indicators, the fulfillment of which is not compulsory, and that the main thing, as it was before, will remain the output of specific types of articles at any price, including through the application of additional resources.

The targets established by the Fundamental Areas for reducing the consumption of the most important types of metal per 1 million rubles of commodity output compel the rejection of such illusions. These targets are the indicators for the five-year plan and the yearly plans for 1986-90.

It must be especially emphasized that the task consists of reducing the metal consumption of articles; that is, the discussion concerns not only economizing rolled ferrous metals, but other types of metal products as well: steel and

cast iron, steel pipe and non-ferrous metals. In this regard, the five-year plan calculations account for a reduction in consumption (per 1 million rubles of commodity output in machine building and metalworking) of 29 percent in rolled ferrous metals, 20 percent in steel sheet, 21 percent in cast iron, 22 percent in steel pipe and 23 percent in rolled non-ferrous metals.

What is the essence of the targets for reducing metals consumption per 1 million rubles of commodity output and their difference in principle from the targets for average reduction in the consumption norms? They determine the necessity of including all of the services of the enterprises, ministries and central planning organs in the work on the economical use of metal resources.

In reality, it is not enough to envisage a reduction in the individual (plant) consumption norms to fulfill the target for reducing metals consumption per 1 million rubles of commodity output. Also essential for this is a pattern of article output and mix that will permit a reduction in metal consumption per ruble of production through: removing backward and metal-intensive equipment from production, increasing the output rate of progressive machinery and equipment and improving the quality and accelerating the placement into production of new equipment. Also important is increasing the level of specialization and the cooperative basis of production and reducing the consumption of metals for spare parts and repair, along with losses.

The introduction of these indicators opens up a broad field of activity at all levels of administration and management. At the same time, the role of the factors for the reduction of individual consumption norms is preserved, but it should be determined by conditions other than those previously in effect.

The annual reduction in the consumption norms is determined today as their difference in the current and plan year for comparable types of products. At a low level of article renewal, it is practically completely comparable not only in the yearly plans, but in the five-year plans as well. Under these conditions, a discussion can be conducted on the continuous reduction of metals consumption for one and the same piece of machinery produced for many years which, naturally, has technical limits. In the 12th Five-Year Plan and in the future, the level of renewal of articles should increase sharply, and therefore the consumption norms will have to be compared and their reductions calculated taking into account changes in the latter per unit of consumer effect for this or that product. The main thing should become not how much the consumption norms for the machinery are reduced, as much as the replacement of machinery with new types.

Proceeding from the above, in our opinion, THE CENTRALIZED PLANNING OF TARGETS FOR AVERAGE REDUCTION IN CONSUMPTION NORMS FOR SPECIFIC TYPES OF METALS BECOMES INEXPEDIENT. These indicators are one of the components of the targets for reducing metals consumption per 1 million rubles of commodity output, and the planning overall and in particular can lead to confusion. RESPONSIBILITY FOR THE CONSUMPTION NORMS IS NONETHELESS BORNE BY THE ENTERPRISES, AND IT IS NECESSARY TO GRANT THEM THE RIGHT TO DETERMINE TO WHAT EXTENT THESE NORMS CAN BE REDUCED FOR SPECIFIC TYPES OF PRODUCTS. THE PROPOSALS OF THE ENTERPRISES SHOULD BE SUMMARIZED BY THE MINISTRIES AND DEPARTMENTS AND SENT ALONG WITH DRAFT PLANS TO USSR GOSPLAN TO BE TAKEN INTO

ACCOUNT IN THE BALANCE SHEETS AND PLANS FOR THE DISTRIBUTION OF SPECIFIC TYPES OF METAL PRODUCTS.

A countervailing opinion to this is that if a target is not established for average reduction in the consumption norm, then the ministries will try to fulfill the targets for the reduction of metal consumption per 1 million rubles of commodity output chiefly through the output of expensive non-metallic articles, the unjustified raising of prices for products and other violations. There is no basis for such arguments, since, in the first place, the principal task of the ministries is meeting the needs of the national economy for sectorial production and the fulfillment of contract obligations for its supply. Consequently, articles no one needs will not be sold. In the second place, even in the face of substantial shortcomings in price formation, it is impossible to imagine a situation where such subjectivism and spontaneity are possible. The more so since specific tasks are posed for the fuller reflection in prices of qualitative indicators of production and the level of socially necessary labor expenditures. Therefore, an effort to achieve a price increase with unchanged product quality is eliminated.

The opinion also occurs that the most felicitous method of supporting a climate for the conservation of metal in machine building, as well as in other sectors of industry and the national economy, is the establishment of targets in the state plans for conservation and reductions in the consumption norms for all types of metal products. Behind the outward attractiveness of this approach is hidden a subjective attempt to have an indicator with the aid of which resources can always be "balanced" with requirements, without being deeply concerned with questions of the structure of production, interchanges of materials, the quality of product output etc. This indicator makes it possible, when there is a resource "shortage," not to analyze the causes and basis of the latter, and simply to increase the target for the reduction of consumption norms and take it into account in planning the distribution of metal products. The approach under review also harbors a fundamental mistrust toward the proposals of the ministries for the conservation of specific types of metal.

It is natural that under the new management conditions it is becoming unacceptable. It would be unjustified, based on a subjective and formalistic method of solving problems in metals conservation, to make even more plump the volumes of decrees with targets for the reduction of consumption norms for specific types of metal resources and to increase the turnover of documents required by the necessity of transmitting these targets, monitoring their fulfillment, reporting, etc. by many times.

In this regard it would be worthwhile to consider WHETHER IT IS EXPEDIENT FOR USSR GOSPLAN TO DEVELOP BALANCE SHEETS AND DISTRIBUTION PLANS FOR SO MANY TYPES OF METAL PRODUCTS. IT SEEMS THAT THEY CAN BE LIMITED TO JUST THOSE OF THEM THAT DETERMINE TO THE GREATEST EXTENT THE RATE AND PROPORTIONS OF THE DEVELOPMENT OF THE NATIONAL ECONOMY. RESPONSIBILITY FOR THE REST OF THEM SHOULD BE PLACED ON USSR GOSSNAB OR THE METAL-ARTICLE PRODUCER MINISTRIES.

There is no need for the ministries to present USSR Gosplan with norms for the consumption of ferrous and non-ferrous metal every year. The "precision" of

calculations of the need for them is an illusion that became obvious long ago. And the point is not that the norms are not progressive, exaggerated and of low quality. On the contrary, long-term practice in planning targets for their reduction has facilitated the overall reliability of setting standards at enterprises, which is testified to by the reporting. The cause of the insufficiently precise calculations of metals requirements according to the consumption norms is that the amount of product output calculated is for an extended product range, including that planned by the ministries, which is not always well-founded to the proper extent. Their elaboration at USSR Gosplan requires a large volume of additional information and is for that reason made more difficult. Through the differences in the volumes of product output according to the plan and the actual underconsumption of rolled ferrous metal versus the resources allocated in the plan, for example, a value is composed commensurate with the volume of yearly conservation of rolled metal in machine building. The preparation of norms at the ministries for submittal to USSR Gosplan is also extremely labor intensive, and reviewing them takes a long time.

The limits of the most important types of metal resources that determine the proportions of the national economy can be fully calculated based on metal consumption per 1 million rubles of commodity output taking into account the targets for their reduction. And this will be no less precise than the norms for consumption, since it has long been known that the aggregated indicators are more resistant to probable changes than are deaggregated ones. Additional resource requirements of this or that ministry with regard to substantial structural changes should be considered specially and where well-founded should be covered through reserves. The control figures for metal requirements for the plan adopted can be implemented according to the base consumption norms, taking into account the conservation targets established by the five-year plan.

The metal consumption norms per unit article, in our opinion, could be submitted to USSR Gosplan by the ministries just once or twice in a five-year plan and can serve to elaborate (where necessary) the scale of its utilization per 1 million rubles of commodity output. At the same time, the planning of just one target for the reduction of metals consumption per 1 million rubles of commodity output would be inadequate.

A most important factor in raising the efficiency of metals utilization in machine building is the acceleration of scientific and technical progress. Consequently, it is important that the plan include a determination of the conditions for providing efficiency indicators. These conditions are in essence the final result of the execution of scientific and technical measures in the sector for the development and assimilation of new equipment and technologies. They should include the economizing of metal (according to aggregate types) through scientific and technical measures; the renewal of products, that is, increasing the share of new types of equipment in overall production volume; and, an average reduction in metals consumption for machinery, as well as of waste and metal losses.

Summing up what has been presented, its seems essential to implement specific measures for raising the efficiency of metal-products consumption in machine building.

FIRST, it is expedient to include in the plan the section "Raising Efficiency in the Utilization and Conservation of Material Resources," including it in the targets for ministries, departments and union republics concerned with the consumption of metal. These targets should be expressed in approved indicators for its consumption per 1 million rubles of commodity output in machine building and metalworking and a reduction compared to the preceding year.

In the plans, it is essential to approve both the absolute volume of metal consumption per 1 million rubles of articles (tons/million rubles) and its reduction versus the preceding year in percentage terms. The establishment of only one of these indicators may not have the desired result. In reality, if just a reduction in consumption is planned, then the exaggeration of base indicators of consumption, as shown by practice, is not eliminated. (Footnote 1) (This shortcoming, in particular, is convincingly attested to by the experience of planning a reduction of consumption factors in ferrous metallurgy. Here, notwithstanding the many years of planning for the reduction of consumption norms of ingots for the production of rolled ferrous metals, the consumption coefficient changed very insignificantly in practice, since an increase in its base size was permitted.) Establishing just the absolute size of metal consumption per 1 million rubles of commodity output is also insufficient, since it is unclear how much the efficiency of metals utilization increases as a percentage of the plan and how much in reality.

It is expedient to establish targets for an aggregate range of metal products: rolled ferrous metal, steel sheet, cast iron, steel pipe and non-ferrous metals.

It is important to retain the reduction in the norms for metals consumption as an estimated indicator as one of the components of a reduction in its utilization per 1 million rubles of product and reflecting the current changes in the metals consumption of articles. The utilization factors of metal and other existing indicators also should be calculated and analytical. Differentiated targets for metal consumption per 1 million rubles of product and its reduction should be transmitted to the enterprises by the ministries. The ministries can also thereby establish these indicators for a wide range of material resources.

SECOND, in the section of the plan on the development of science and technology, it is important to plan not only the chief measures of scientific and technical progress, but also to determine the estimated indicators that characterize the effect of their incorporation and are associated with improving designs, technology, the organization of production and the renewal of products. These indicators could be: metals conservation (by aggregate type) through the execution of measures of scientific and technical progress; reduction in the design metal consumption of machinery and equipment in

percentage terms; reduction of metals waste and losses in percentage terms; and, product renewal in percentage terms.

In order to characterize the growth of product quality in machine building, the composition of the cited targets should be supplemented with indicators of the reliability and longevity of the machinery and equipment.

All of these indicators should be differentiated and delivered to the associations and enterprises in specific form for the organization of work on the spot for planning and setting up the production of equipment that is distinguished by lower metals consumption and substantially improved indicators of reliability and longevity.

THIRD, it is expedient to create a management system for resource conservation that includes the management of metals conservation. With this aim, work should be organized in centralized planning organs, ministries and enterprises on raising the efficiency of utilization and the conservation of material resources. This means the purposeful and interconnected activity of all the services of the ministry or enterprises, directed toward the realization of the dedicated task of reducing the materials and power consumption of products. The obligations and responsibilities of all subdivisions should be clearly determined for its resolution, which requires the development of sectorial and departmental statutes.

Coordinating the work on managing the efficiency and conservation of metals can be entrusted to the resource norm-setting subdivisions with the appropriate elaboration of their rights and obligations. They could take upon themselves the organization and methodological guidance of this work, the formulation of indicators and the resolution of other issues.

Finally, FOURTH, incentives for metals conservation require improvement. A procedure must be created that determines the procedure for accounting for conservation as the result of specific measures, as well as a personal account for economy. The personal account should become the sole official document that records the instance of economy and is the basis for the payment of material compensation. The payment of compensation to individual specialists should not depend on the overall results of the economic activity of the enterprise. The guarantee of incentives for economizing for the appropriate personal accounts will yield appreciable results. It is important in this that the procedure for formulating the accounts be sufficiently simple both in formulation and in the aspect of control over the reliability of the economy of metal obtained.

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INDUSTRY PLANNING AND ECONOMICS

KRASNYY PROLETARIY PLANT ON METAL USE, NC TOOL BENEFITS

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 86 pp 46-49

[Interview with Moscow Krasnyy Proletariy Machine-Tool Building Production Association Chief Process Engineer Vyacheslav Nikolayevoich Panin by journal department editor N. D. Golovnin under the rubric "Our Interview": "Setting Norms for Material Resources at Enterprises"; material in capital letters is in boldface type in original]

[Text] The materials of the 27th CPSU Congress pose the task of achieving the fact that the increase in the requirements of the national economy for material resources be 75-80 percent satisfied by way of economizing them. The fulfillment of this task depends on how successfully it is resolved at every specific plant, mill and construction site. In an interview with journal department editor N. D. Golovnin, Moscow Krasnyy Proletariy Machine-Tool Building Production Association Chief Process Engineer V. N. Panin relates possible ways of raising the efficiency of metals utilization in machine building.

[Question] The 12th Five-Year Plan plans to provide for a growth in the output of machine-building products with practically no increase in metal supply, which requires the execution of measures for reducing metals consumption and improving the setting of norms for metal requirements. How are these tasks being resolved in your association?

[Answer] Metal is the principal structural material of machine building. A considerable portion of material expenditures for product output falls to its share. Under the conditions of shifting the economy onto an intensive path of development and turning resource conservation into a principal source for satisfying the increase in requirements for raw and other materials, questions of economizing metal acquire paramount significance. This is reflected in the everyday activity of designers, process engineers and the whole collective of the association. The set of measures for economizing metal is a constituent part of the plan for the social and economic development of the association. As a result of its implementation, a yearly reduction in the norms for metals consumption and its considerable economy are ensured. In 1985, for example, a reduction in the consumption norms allowed us to conserve 1,608.5 tons of hot-

rolled metal at a yearly requirement volume of 17,444 tons. In 1986, it is proposed to reduce the consumption norm by 7 percent (the ministry target for its reduction is 5 percent) and through this to conserve 1,510 tons of metal. At the foundation of this norms reduction is the improvement of the design of machine tools and the expansion of the utilization of progressive materials and technologies. All of this ensures a gradual reduction in metals consumption for every model of machine tool over the course of the whole period of its production.

At the same time, materials consumption per machine tool in the transition from one generation to another, as a rule, is increasing. The new-generation machine tools are fitted with additional devices for, for example, the automated control and management systems (to which the corresponding technological functions of man are transferred), which increases the mass of the machine tool, and this is frequently not compensated for by the reduction in metals consumption through other factors. At the same time, new machine tools, for example machine tools with NC [numerical control], possess greater consumer value and generate a considerable economic saving (depending on the model, from 6,400 to 12,000 rubles per machine tool).

In comparing the materials consumption of various types of machine tools, therefore, it is essential to take their consumer value into account as well. Thus, in a near doubling in the mass of NC machine tools compared to general-purpose tools with manual controls, the productivity of machine-tool operators in servicing just one machine tool increases by 2-3 times. Consequently, relative to this most important indicator of the consumer value of machine tools their metals consumption is reduced, but there is no such accounting. A technique has not been developed. It should be acknowledged that there exist reserves for decreasing the norms for metal consumption in the production of NC machine tools. Thus, a reduction of 17 percent for the new models is proposed for our association in 1986.

[Question] Strengthening the struggle for metals economy in the national economy was accompanied by an increase in the number of directive indicators for its conservation. Is such a regulation of the use of metal justified?

[Answer] In order to answer this question, it is necessary to remember the aims for which the work on economizing metal is being conducted. The discussion concerns reducing its expenditures per unit of consumer value or, in other words, satisfying a given amount of specific public needs (for metal-cutting machine tools, for example) with the least consumption of metal. Consequently, the end result is specific--to conserve the maximum possible amount of metal for the manufacture of an additional amount of products needed by the national economy. Achieving it depends on a multitude of factors. The attempt to account for and control even the principal ones (design improvements, the improvement of technology, the application of progressive materials) caused an increase in the number of indicators, as a result of which attention toward the final purpose was weakened to some extent. In and of itself, the real economizing of metal seemingly recedes to the background, and the necessity of fulfilling indicators that depend, as is well known, on the norms advances to the forefront. Coordination is lacking for these very same indicators, and opposite dynamics are possible. The maximum economy of

metal under specific economic conditions, moreover, can often be ensured by improving one or several indicators, with the others remaining unchanged or even worsening. Thus, a considerable economy of metal is produced by reducing the norms for its consumption per unit article. In this, however, a reduction often occurs in the utilization factor of the metal, caused by the fact that in decreasing the mass of the blank, the allowances remain practically unchanged, and the technological level of the equipment used in the planning period does not permit them to be reduced. For example, improving the design and manufacturing technology of the basic 16-K-20F3 machine tool with NC made it possible to reduce its mass from 660 to 600 kg [kilograms], and of the cast blank from 1,140 to 1,100 kg, which ensured a saving of 40 kg of steel per machine tool. The utilization factor of metal, however, declined from 0.58 to 0.55. This is a typical example. Many other such examples could be cited. The circumstance that the utilization factor of metal is directively increased indicator, and its reduction is regarded as a worsening of operations in metals economy, has an effect. As a result, the implementation of measures directed toward considerably reducing metals consumption is restrained.

To our view, the given factor should be estimated and analytical, and not increased by directive. A change in its nature would allow the elimination of the possibility of its increase by the use of heavy, metal-intensive parts. Losses from such a use of metal, long excluded from circulation, are considerably greater than expenditures for the collection, transporting and reworking of metallic chips, which are used as a secondary raw material. Naturally, the discussion does not concern underestimating the role of the metal utilization factor. This is an important analytical indicator, and its value, when the vested interest of enterprises in an artificial increase for the sake of achieving the plan value is eliminated, quite objectively characterizes the progressivity of the technologies employed and the efficiency of metals use. The significance of economic factors for increasing it, moreover, prevail over the existing reserves at enterprises.

The decisive role of providing the enterprises with progressive types of rolled metal, castings, stampings and other metal articles that have minimal tolerance for finish machining in raising the metals utilization factor should be emphasized. Efficient metals machining equipment that permits the use of leading technology is also required. All of this is still lacking. But this is a problem for the national economy, for the resolution of which are required a certain period of time and additional expenditures.

The tolerances of blanks obtained via cooperative supply do not correspond to modern requirements. Frequently they exceed those allowable for the corresponding types of metal articles manufactured in-house by 2-3 times. But that is not so surprising--such large tolerances meet the requirements of state standards, that to a great extent take into account the interests and capabilities of the suppliers more than of the consumers.

The strengthening of cooperative supply has a substantial effect on the results of the economic activity of enterprises. Thus, 70 percent of the requirements of our association for component assemblies and blanks is satisfied by cooperative supply. They must therefore be made more strict and oriented first and foremost toward the satisfaction of economic requirements

in order to raise the influence of state standards on the growth of production efficiency.

A large role in mobilizing the efforts of labor collectives for the rational utilization of metal is reserved for the annual targets for reducing the norms for its consumption. As is well known, however, in the face of the quite successful fulfillment of these targets, radical shifts in metals economy did not occur in the last 10-15 years. This is along with inadequately high rates of improvement in the structure of metal produced, the dissemination of progressive technologies and the slow assimilation of the achievements of scientific and technical progress as well as connected with certain imperfections in this indicator and in its employment in practice.

THE DIRECTIVE INDICATOR FOR THE REDUCTION OF THE CONSUMPTION NORMS IN PLANNING FROM WHAT HAS BEEN ACHIEVED DOES NOT STIMULATE THE ENTERPRISES TO UTILIZE ALL RESERVES AND, MOREOVER, FORCES THEIR CREATION FOR THE FULFILLMENT OF TARGETS IN THE FUTURE. THIS REDUCES THE AMOUNT OF REAL METALS SAVINGS COMPARED TO WHAT IS POSSIBLE.

In work on reducing the metals consumption norms, it is essential to take into account such a factor as the reduction of aggregate expenditures for the production of a unit of product. A saving of metal that is accompanied by an increase in the consumption of other resources and leads to an increase in the cost of the articles produced is hardly justified.

In small-series production, the saving from the use of progressive technologies that considerably reduce the metals consumption norm exceeds the increase in labor intensiveness. In the hot die forging of a small lot of parts, in particular, the additional labor expenditures for manufacturing the die increase their cost to a greater extent than it is reduced through a saving of metal.

It must be acknowledged that UNJUSTIFIED HIGH PRICES FOR PROGRESSIVE TYPES OF STRUCTURAL MATERIALS DO NOT FACILITATE A REDUCTION IN AGGREGATE EXPENDITURES. The use of these materials, decreasing the expenditure of metal in physical terms, often increases the cost portion of the value of product output.

[Question] Vyacheslav Nikolayevich, what you have said gives rise to the question of what changes should be made in the system of planning metals economizing?

[Answer] First and foremost, it is necessary to reduce substantially the number of directive indicators for metals economy sent to the enterprises. The reduction of metals consumption per unit of product should be the main thing in the evaluation of the rationality of its utilization. To a great extent, the indicator for reducing metals consumption per 1 million rubles of commodity output that was included in the current five-year plan corresponds to this requirement. It takes into account all factors that are reflected by metals consumption norms, its utilization factor and other indicators that can be made into estimates. At the same time, this indicator also has a substantial shortcoming: the possibility of ensuring its fulfillment not only through a real economy of metal, but by means of making product output more

expensive. In this regard, the question arises: do some special indicators for metals economy have to be given to the enterprises if production should grow without additional funds? Thus, in the current five-year plan, the machine building industry has to provide for a growth in product output with practically no increase in the supply of metal, which in and of itself predetermines the necessary scope of its economy. In this, it is not the fulfillment of a multitude of indicators for metals economy, but the economy itself that becomes the immediate aim of the labor collectives.

Under these conditions, a reduction of the norms for metals consumption will have to be achieved not with regard to its actual values in the base-year period, but compared to progressive and technically well-founded ones, for which it is essential to include all the resource-conserving factors of scientific and technical progress and organizational and technical reserves.

The responsibility of planning and sectorial organs for providing the enterprises with resource-conserving equipment and progressive types of structural materials and for the widespread incorporation of leading experience should increase.

Such an approach to resolving the problems of economizing metals, in our opinion, corresponds to the requirements of the 27th CPSU Congress on the re-orientation from quantitative indicators to qualitative ones, from interim results to final ones, and from increasing resources to improving their utilization.

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INDUSTRY PLANNING AND ECONOMICS

AUTOMATION, FLEXIBLE SYSTEMS USE IN CONSTRUCTION INDUSTRY

Moscow STROITELNAYA GAZETA in Russian 3 Aug 86 p 1

[Unattributed article: "Renewing the Base of Housing Construction"]

[Excerpts] The solution of the housing problem in our country is associated is a most direct fashion with accelerating scientific and technical progress in the housing construction industry.

The complete redesign of 80 plants that produce pre-fabricated structural elements is projected over the five-year period. Some 20.4 billion rubles were allocated for the development of the whole construction industry, including for the reconstruction of housing construction, in 1986 alone. In order to utilize these colossal funds in a thrifty manner, it is very important to determine correctly the strategy and tactics of the renewal of production. Our domestic housing construction industry must be raised to a higher level, and products should come from its conveyor to adorn our cities.

Many technical innovations have appeared in the technical arsenal of the sector in recent years. These include the cassette-conveyor lines for the manufacture of interior-wall panels, mechanized lines for exterior-wall finishing by various methods, and the speedy directed feeding of concrete in special hoppers. Attempts are being made to employ robot equipment in production: the first manipulators have arrived in shops at plants. Of the 545 existing large-panel housing construction plants in the country, 434 enterprises have made the transition to the output of new-series homes.

Overall, however, housing construction developed along the extensive path in the 1970s and 1980s. The increase in the volumes of pre-fabricated structural elements manufactured was achieved chiefly through increasing the number of enterprises. The mass production of new and promising equipment was not set up. Housing construction has one of the lowest fixed-capital renewal factors. Minstroydormash [Ministry of Construction, Road and Municipal Machine Building] and its institute, Giprostrommash [All-Union State Planning and Design Institute of Establishments of the Construction Industry], called upon to equip the housing construction industry with modern equipment, have not undertaken this work in an energetic fashion over many years, and prospects for the sector have been lost. The so-called new standard and experimental plans, created by Giprostrommash, do not provide for any substantial increase

in the operating efficiency of enterprises. Moreover, the new process lines do not even make it possible to reach the level achieved at the best first-generation large-panel housing construction plants.

The Soviets of Peoples' Deputies have been called upon to play a more active role in developing the capacity of the construction and building-materials industries and in the reconstruction and technical retooling of existing enterprises. The recently adopted decree on "Measures for Further Increasing the Role and Strengthening the Responsibility of Soviets of Peoples' Deputies for Accelerating Social and Economic Development in Light of the Resolutions of the 27th CPSU Congress" grants them the right to create special enterprises and to include associations, enterprises and organizations in this work on a proportionate basis.

The leading housing construction institute in the oblast--TsNIIEP zhilishcha [Central Scientific Research and Planning Institute of Standard and Experimental Planning of Housing]--has recently become more active. The flexible system of panel housing construction proposed by them opens up broad possibilities for raising the efficiency of production and architectural searching and has been approved by Gosgrazhdanstroy [State Committee for Civil Construction and Architecture].

It seems expedient to create a scientific planning and design production association on the basis of the appropriate subdivisions of TsNIIEP zhilishcha, Giprostrommash and Minstroydormash, the activity of which would be subordinated to a single purpose--the incorporation of progressive technical and architectural solutions in housing construction practice. This would make possible a closer coordination of issues in planning, architecture, technology and design and ensure the most rapid manufacture of experimental and test-production prototypes of new machinery and their incorporation into mass production. The sectorial economic institutes must develop those systems of material incentives that will induce collectives to produce architecturally varied products.

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INDUSTRY PLANNING AND ECONOMICS

BRIEFS

PARTY MEETING ON MACHINE TOOLS--(TASS)--On 21 May the Central Committee of the CPSU held a meeting on the topic of the future evolution of the machine building sectors and the enhancement of the technical aliber and quality of the manufactured products. Taking part in the meeting were comrades N. I. Ryzhkov, L. N. Zaykov, N. V. Talyzin, deputies of the President of the USSR Council of Ministers A. K. Antonov, I. S. Silayev, Yu. D. Maslyukov, and G. I. Marchuk, ministers, chairmen of the state committees, and high-placed members of the CPSU CC. A long speech was given by the General Secretary of the CPSU CC, M. S. Gorbachev. It was pointed out at the meeting that, since the April (1985) plenary session of the CPSU CC, an active program has been set in motion to accomplish the national goals of development of machine building in the 12th Five Year Period and over the term up to the year 2000. The machine building sectors have worked up to a steady pace. The greatest progress in this regard is being achieved where there is a changed attitude toward the matter, and where the work collectives are actively included in the search for innovation, displaying initiative and responsibility in solving the tasks of design, manufacture and promotion of progressive technology and engineering. Special attention was devoted to the allocation of high quality materials and products to the machine building sectors, intensified in-house machine tool construction, and giving the priority to the development of instrument design, electrical engineering and electronics. At each institute, at each design bureau, it is essential to have a system of objective evaluations of the technical caliber in light of the dynamism of the scientific and technical revolution. The introduction of Soviet inventions should be accelerated, and the entire system of scientific-technical information improved. It was underscored that the directors of the machine building ministries, associations, and enterprises, and the scientists and experts will soon have to tackle the critically important task of placing Soviet mechanical engineering at the forefront of the world. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 May 86 p 1] 12717

FACTORY WORKERS DONATE FREE TIME--Yelets--A collective of the Yelets factory Elta have unanimously supported the initiative of the workers of the Volga Automotive Plant to spend four free days in the present year working without pay on public works projects. During their off time, the machinists will labor in the construction of a municipal hospital, a factory-shared polyclinic, an apartment house being erected on the economical principle, and a number of other public facilities. [By N. Klimov] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 6 Jul 86 p 2] 12717

CSO: 1823/302

METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

UDC 621.9.06.004.67
658.588.8

UNIVERSAL FIT-UP JIGS FOR REPAIR WORK

Moscow MASHINOSTROITEL in Russian No 5, May 86, pp 32-34

[Article by engineers V. V. Tkachenko and V. P. Yudin]

[Text] With the increasing demands on quality of maintenance and repair of metal-cutting lathes, the mechanisms, jigs and gages used as accessories take on special significance. An effective way to improve equipment repairs is the use of universal fit-up jigs. This is a collection of mutually interchangeable parts and components. In particular, the universal fit-up jigs for repair work at one of the enterprises include three basic sets of parts and components: gages; machining jigs; and assembly-dismantling jigs.

The first set consists of parts and components of 90 kinds. These are used to put together jigs intended for checking the assembly and compliance with precision standards for the majority of types of popular lathe models. Thus, the jig (Fig. 1a) is used to check that the guideways of the basic components of metal-cutting lathes are parallel, rectilinear and plane; the jig (Fig. 1b) is used to check that the axis of the spindle of a drilling head is normal to the guideways of the arm in radial drills; the jig (Fig. 1c) is used to check that the guideways of the yoke in cutting mills are parallel with the axis of rotation of the spindle in the vertical and horizontal planes. These jigs (with certain modifications and supplementations) are assembled from the identical basic standardized parts: a locating base (ruler) 1 with two T-shaped continuous slots along the upper and lower working surfaces, a holder 4 secured to the base for attachment of a system of rods with a gage, an adjustable mandrel 2, a nonadjustable mandrel 5, a leveller 3, and a rod 6. The elements are secured to the basic components by a standardized dowel 7. To enlarge the technological possibilities of the set of parts and components of the measurement jigs, many of the components (the rulers, rods, mandrels, etc.) come in several sizes.

The second set consists of parts and components of 50 kinds, used in mounting, checking the alignment, and fastening of the basic parts of lathes being repaired by machining. The set includes various types and sizes of jack, clamps, rests, self-aligning supports, measurement plates, grinding heads, and other parts and components which can be used to fit out, for example, the lengthwise grinders and lengthwise planers of repair machine shops.

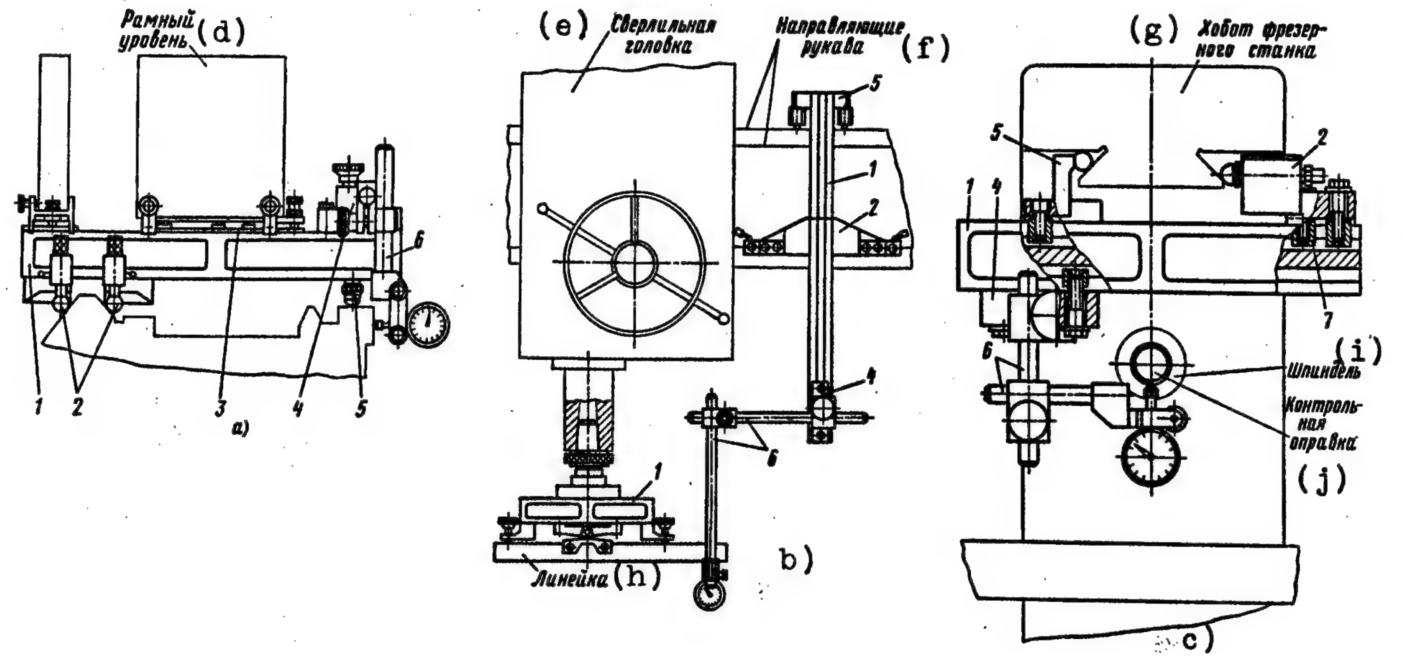

Fig. 1

Key:

d. Shoulder level
e. Drilling head
f. Arm guides
g. Yoke of cutting mill
h. Ruler
i. Spindle
j. Checking mandrel

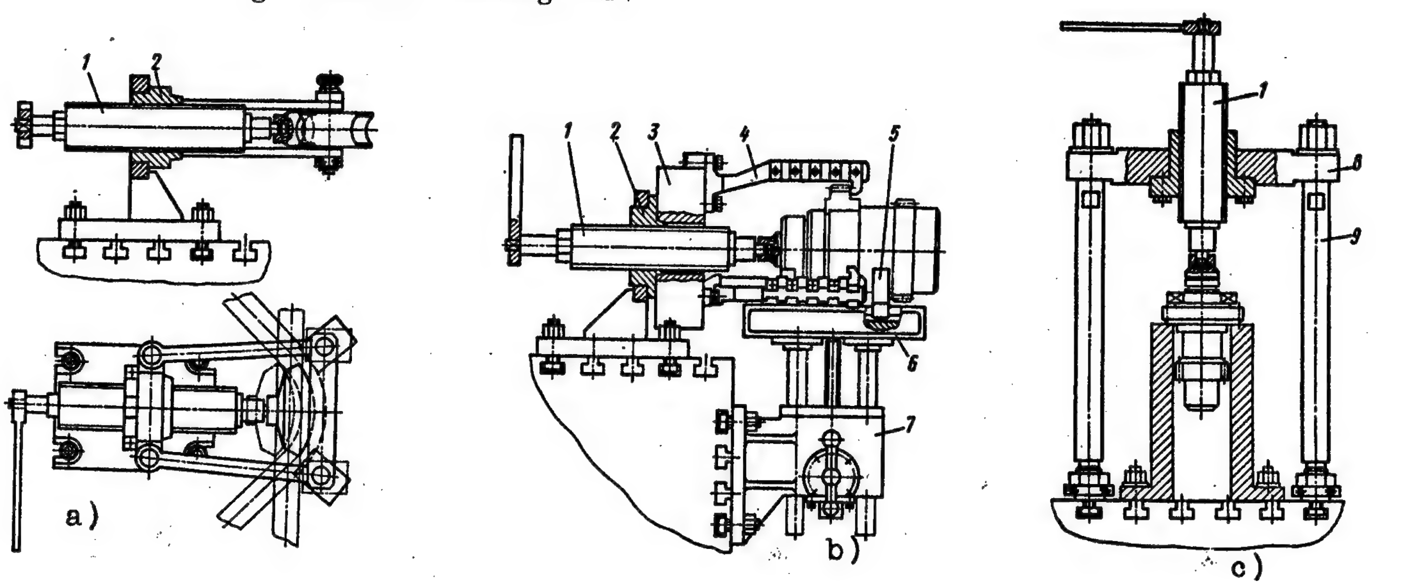

Fig. 2

The third set includes parts and components of 45 kinds. These are used to assemble jigs for press-fitting, pressing out, pipe bending, stripping, and so forth. Figure 2a shows a portable pipe bender, the basic parts of which are a hydraulic amplifier 1 and a stand 2. These same elements are used in the stripper (Fig. 2b), assembled from a self-centering, triple-cam lathe chuck 3, with standardized clamps 4 fastened to the cams. The jig includes a lifting mechanism 7 with vee-block support 5, which is fastened to a ruler 6 (cf. the jig of the first set). The same hydraulic amplifier 1 is used in a table-top press (Fig. 2c), where the other parts (stands 9, cross arm 8) are standardized.

It is very difficult to provide all the versions of the parts, components and ensembles of universal jigs that may be needed in the repair of lathes. Therefore, it is also necessary to employ special parts, not part of the set, in putting together the jigs. The use of the universal jigs does not preclude other kinds of repair accessories.

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METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

TURKMENISTAN'S PLANS TO DEVELOP METAL INDUSTRY DISCUSSED

Ashkhabad TURKMENISTANSKAYA ISKRA in Russian 4 Jun 86 p 2

/Interview with Yevgeniy Ivanovich Martynov, Deputy Chief Engineer of the All-Union Scientific Research and Planning Institute of Refractory Metals and Alloys, by R. Bazarov; date and place not specified/

/Text/ Specialists of the All-Union Scientific Research and Planning Institute of Refractory Metals and Alloys have completed the development of a plan for the Turkmen Hard Alloy Products Plant. The basic directions of the economic and social development of the country for the present five-year plan and up to the year 2000 provide for the start of construction of this plant.

The deputy chief engineer of the institute, Ye. I. Martynov, comments on this:

"I will begin with the fact," Evgeniy Ivanovich said, "that this will be the first such plant in the country. It is true that we have sections in the shops of some plants that have been manufacturing these products for several years now. However, a specialized plant is being built for the first time--with proper production rates and an output volume which permits building it, if you wish, as a beautiful thing in the sense of automation, production esthetics, and environmental preservation.

"Now about production itself. Everyone, even a person far removed from metal-cutting, has an idea, even if vague, of this process. Here, for example, a lathe operator is working. He inserts the cutting tool, leads it to the rotating blank, and removes the shavings. When the cutting tool becomes dull, the lathe operator must resharpen it. The cutting tool lasts about a half dozen sharpenings and, at the same time, expensive refractory metal is lost. We notice that the sharpening is done by eye. High precision, quality, great speeds and cutting depth cannot be required here. This is the past, a little of the present, and really nothing of the future.

"Meanwhile, the strategy for accelerating the social and economic development of the country, developed by the party at the 27th Congress, envisions, in particular, major changes in machine building with the help of the scientific and technical process. Can these tasks be carried out with the previous speeds and quality of metal machining? Not at all. A revolution is approaching in machining metal and it has already begun. Those products which the Turkmen workers will produce at the new plant are destined to speed up its course.

"Here they are." Yevgeniy Ivanovich held out a handful of metal tool tips with a round opening in the middle; each one the size of a thumbnail and weighing tens of grams. "What, are you disappointed? Did you expect to see something more complicated? These hard alloy non-regroundable tool tips are priceless. That is, a price has been determined. I will say for interest's sake that if such a tool tip costs up to 12 dollars in America, then for us--even less than a ruble--from the set profitability level. 'Priceless' --in the sense that these tool tips are intended to equip the cutting tool with the highest level of accuracy--up to 12.5 microns--which makes it possible to use automated lines with numerical control in machining metal. They provide an unprecedented cleanness, with modern machining technology, of the machinable surface, depth of cut, increase in speeds, and sharp growth in labor productivity. In short--a genuine revolution. On top of everything else, the tool tips are non-regroundable, i.e., expensive metal losses have been eliminated."

/Question/ Yevgeniy Ivanovich, you said that there are already sections at various plants where such a tool is being produced...

/Answer/ Yes, but there are very few at the present time. Practically speaking, only two motor vehicle plants have this super-precise tool available--the Volga and Kama plants. But the need for it is enormous. So it was decided to build a plant in Turkmenistan which can cover a significant part of the shortage.

/Question/ What prompted the decision to build such a plant in our area--was it the availability of raw materials or other reasons?

/Answer/ Very little raw material is needed here. This is low metal-intensive production but it employs a large number of people. We can literally ship the entire volume of tool tips manufactured here in a year in one airplane. Thus, neither raw material nor transportation has limited us.

The Council on the Study of Productive Forces and Resources of USSR Gosplan /State Planning Committee/ proposed several sites to us: the Volga area, Siberia, the Urals, and your area. Turkmenistan was selected because of the interest in developing your region and because of the fact there is an abundance of labor here.

/Question/ An abundance of labor... Yes, our republic has one of the highest birthrates in the country. At the same time, skilled specialists are required at each plant. What are your calculations in building the plant and where is the confidence that these thousands of laborers will be found?

/Answer/ This is a tough question. However, we are really confident that people will come to the plant and very willingly. And this is why.

This is an enterprise of the highest labor efficiency--I have already said that precisely because it is specialized, it can be thought of as beautiful and interesting. Imagine a gigantic, by our scale, shop about 500 meters long and 80 wide. It is covered with automatic machine tools with numerical control. People are working on them in white coveralls. A person has taken a small container, put 50 tool tips in it (all of this will weigh 500 grams), and place it on the machine tool. And further, mechanical arms themselves will bring the tool tip to the grinding machine and will carry out all required operations.

The work is absolutely clean, there are no harmful wastes. For example, the plant will not have a sewer system--full and independent water circulation, closed cycle, with only feed maintenance going on.

The plant will be built near Ashkhabad. If, in the first place, 90 million rubles have been allocated, then 25 million of them are for the construction of housing and the compulsory trade schools where people will learn a skill. The enterprise needs highly-skilled specialists--metal machinists, powder metallurgists, heat specialists, power engineers, etc. The plant town will have its own children's facilities, clinics, a recreation area, and Pioneer camp.

/Question/ One would very likely really want to work at such a plant...

/Answer/ It is not only one of those enterprises which establishes a city. It will influence many aspects of the life of Ashkhabad. There will be a stimulus to develop a secondary school and a college--so many specialists will be necessary! It will also entail an expansion of science. The intention is to organize at the plant its own scientific facility. We will attract some people from other regions but mainly they will grow their own scientific personnel. The first shop we are thinking of constructing is an experimental one so that science will have space for exploration.

/Question/ When do they intend to begin construction and when will it be completed?

/Answer/ After the plan is approved, we will begin working on the blueprints. The construction project will open next year and it will be completed in the 13th or the beginning of the 14th Five-Year Plan. The construction base here, as we saw, is not bad. According to our estimate, the intention is to put about another 10-12 million rubles into the development of the republic's construction industry.

Life is going forward. Much is already being done now to increase labor productivity at the future plant in comparison with those sections which are manufacturing such non-regroundable tool tips now. You cannot cover everything in one conversation. However, I would still like to stress this: when people find out what kind of work awaits them, they will come with pleasure to this plant which is being built--the only one of its kind in the country at the present time.

8524
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METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

UDC 621--752(031):62.19

VIBRO-ACOUSTICAL DIAGNOSTICS OF LOAD-SUPPORTING SYSTEMS OF METAL-CUTTING LATHES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 6, Jun 86, pp 158-159

[Article by candidate of technical sciences and docent V. P. Zelik, aspirant A. I. Astapenko and aspirant Ye. V. Shram]

[Text] A new approach is considered to the vibro-diagnostics of load-supporting systems, involving discrimination of the normalized spectrum of the load-supporting system from the overall spectrum of the machine tool by translating all vibrational sources of the rotory mechanisms into the class of nonstationary processes. The resulting spectrum can be used as a diagnostic feature in automated vibro-acoustical diagnostic systems.

Within the familiar methods of technical diagnostics of rotory machines, especially vibro-acoustical diagnostics, the main attention is usually paid to the moving parts. By the same token, in the case of metal-cutting lathes, insufficient attention is paid to the diagnostics of damage of the body parts.

Let us consider a technique of isolating the normalized spectrum of the load-supporting system from the general spectrum of the machine tool [1] and its use as a diagnostic feature in automated vibro-acoustical diagnostic systems. The model of the process is the dependence of the frequency and figure of merit of local, internally resonating segments and of the normal forms of vibration of the load-supporting systems of the machines on the presence and subsequent development of crack type defects.

The essence of the technique of discriminating the spectrum of vibrations of the load-supporting system consists in translating all sources of vibration of the rotory mechanisms into the class of nonstationary processes, to which the correlation spectral processing methods are not sensitive. This is accomplished by a processing of the information obtained from vibrational pickups over time intervals corresponding to the speed-up or slow-down of the drive units.

The correlation function of the process:

$$x(t) = x_{H}(t) + x_{\Pi}(t, \varepsilon)$$

will then have the form:

$$R_x(\tau) = R_{xH}(\tau) + e^{-|\alpha(\varepsilon)|\tau} R_{xH}(\tau),$$

where $x_H(t)$ is the time series formed by the vibrations of the elements of the load-supporting system of the lathe; $x_{\Pi}(t,\varepsilon)$ is the time series formed by vibrations of the elements of the drive units, whose frequencies are dependent on the frequency of revolutions $\omega(t) = \omega_0 + \varepsilon t$; ω_0 is the initial frequency of revolution; $\varepsilon = \dot{\omega}(t)$ is the angular acceleration; $|\alpha(\varepsilon)|$ is a function dependent on ε.

For each ε there exists such interval $\Delta\tau$ where:

$$R_x(\tau) \approx R_{xH}(\tau). \tag{1}$$

An experimental investigation of $\Delta\tau(\varepsilon)$ has led to a formula which is sufficient for practical purposes:

$$\Delta\tau > (3 \div 5)\,\frac{2\pi}{\omega_{min}},$$

where ω_{min} is the minimum resonance frequency of the load-supporting system.

The estimates of the normalized function of the spectral density $G_H(\omega)$ of vibrations of the load-supporting system of the lathe, obtained over specified intervals of time as per the correlation function (1), are subjected to analysis for the purpose of revealing the dynamism of their variation by using the integral estimates [2]:

$$U(t_i) = \int_{\Omega} \frac{1}{|\omega|} \ln \frac{G(\omega, t_i)}{\lambda^2}\, d\omega,$$

where λ^2 is a constant parameter dependent on $D^2[\eta(t)]$, which is the dispersion of the independent Gaussian uncertainty $\eta(t)$; $1/|\omega|$ is a weighting function of the frequency, Ω is the frequency region in the neighborhood of ω. We shall evaluate λ^2 from the equation:

$$D^2[\eta(t)] = \frac{1}{\pi}\int_0^\infty \min[\lambda^2, G(\omega, t_i)]\, d\omega.$$

Experimental investigation of a model KZh 9340 lathe in shop conditions has confirmed the effectiveness of this technique.

CONCLUSIONS

1. Using the developed method of differentiation of the sources of vibro-acoustical oscillations enables a solving of the problem of diagnostics of the load-supporting systems of metal-cutting lathes.

2. The estimates $u(t_i)$ define the dynamism of development of a defect and may be used for purposes of forecasting.

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12717
CSO: 1823/327

OTHER METALWORKING EQUIPMENT

SHIPBUILDING MACHINE SERIES DESCRIBED

Moscow TECHNICHESKAYA ESTETIKA in Russian No 4, Apr 86

[Machines Commissioned by the Shipbuilding Plant imeni the Lenin Komsomol, Komsomolsk-na-Amure, designers A. A. Nikulin and Yu. A. Konovodov, Far East Branch of the All-Union Scientific Research Institute of Engineering Esthetics]

THE AMUR AUTOMATIC WELDING MACHINE

[Text] The machine is designed for making joints in various spatial positions. The welding is done in a protective gas environment. The machine travels along a toothed rack.

Unlike the prototype, which consists of two hinged elements--a welding head and a trailer--the new design accommodates all elements of the machine on a single platform. This enables a smaller size, less metal in the design, and a reduced number of current plug-and-socket connections. A rational configuration of the controls increases the ease of guiding the machine.

There are standardized handles (absent from the prototype) for setting the machine in the working position and for transport. The need for protection against the welding arc and the smoke has also been considered: there is a protective chamber.

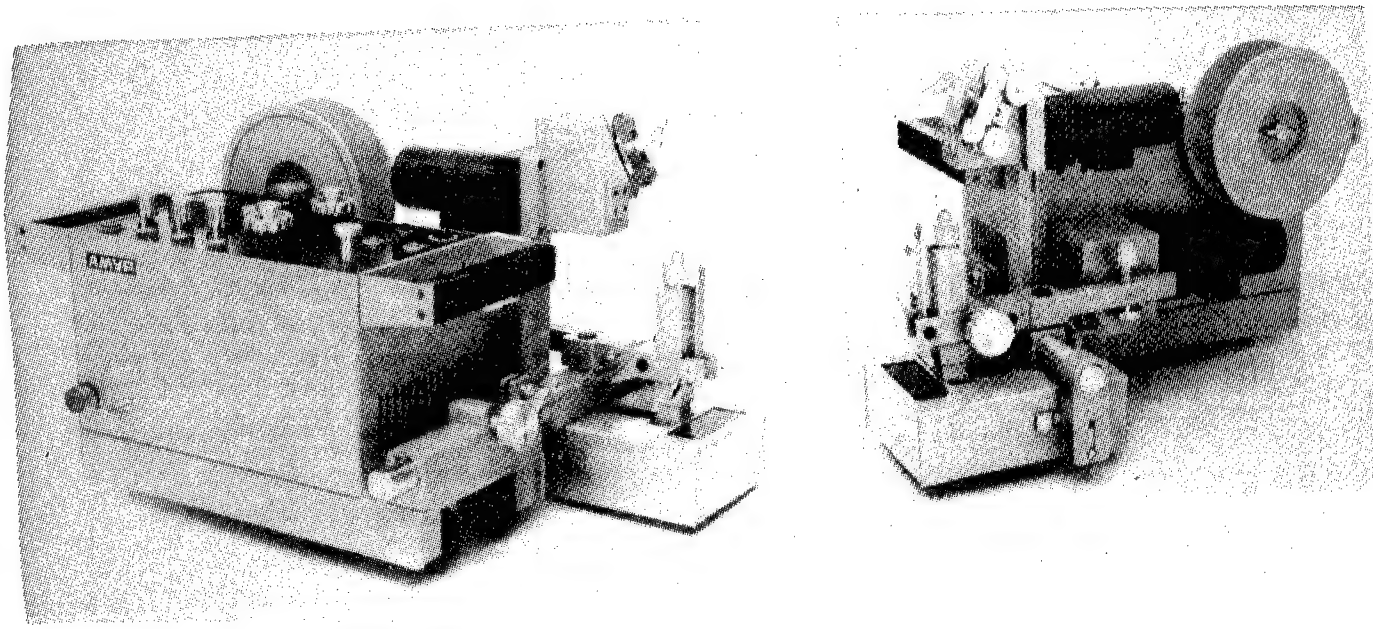
A plastic design for the contour elements (in particular, the housing, the protective chamber, and the carriage) was adopted in view of the technology of bending and welding which is convenient for small lot manufactured items.

A test model has currently been built and is undergoing industrial testing.

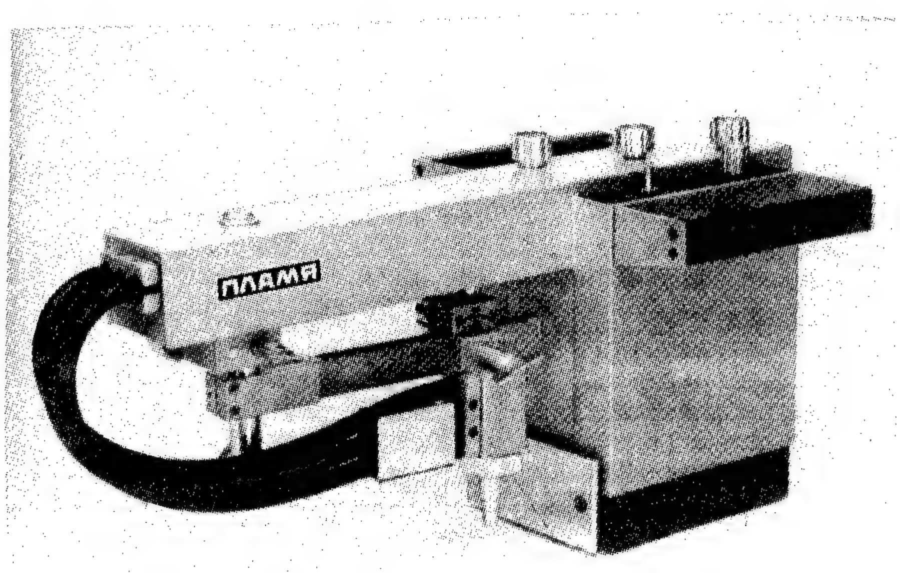
THE PLAMYA GAS CUTTING MACHINE

[Text] The machine is used to make openings in the hull of a ship and can operate in the horizontal or vertical plane. The machine is held in its working position by electromagnets.

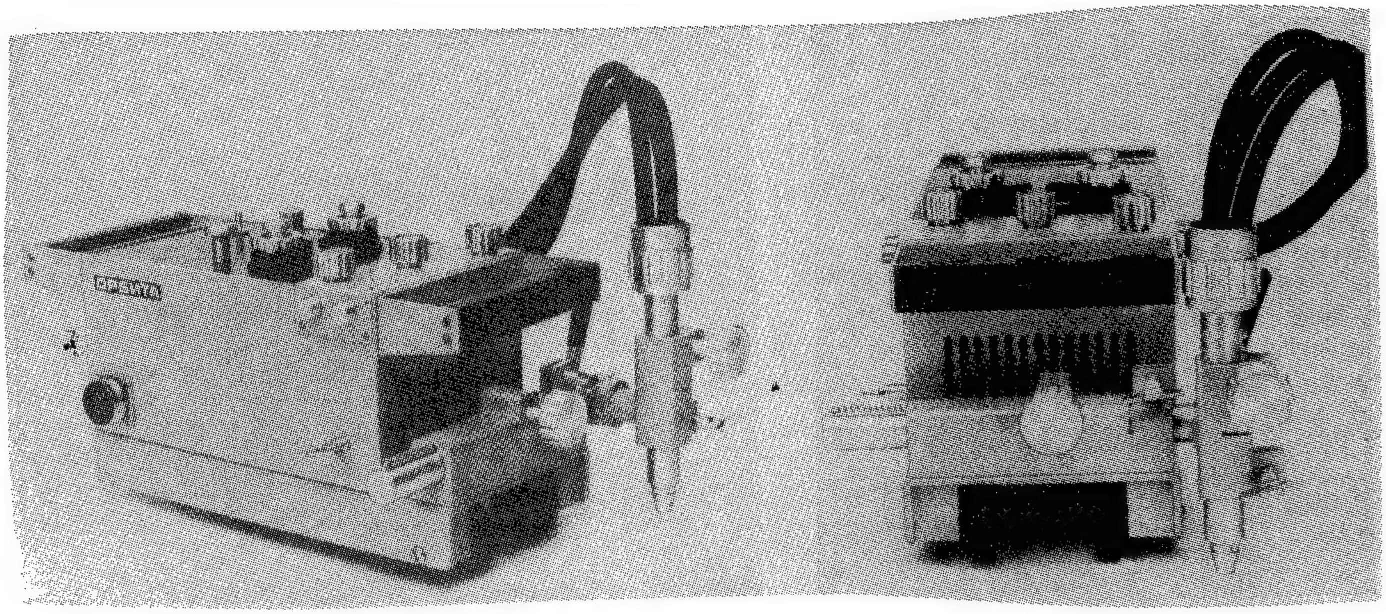
A panoramic cutting zone has been engineered into the design. For this, a single rack is used, instead of the four supports of the prototype. This rack houses the electromagnets, a drive system, and a light, which is required when working in dimly lit locations.



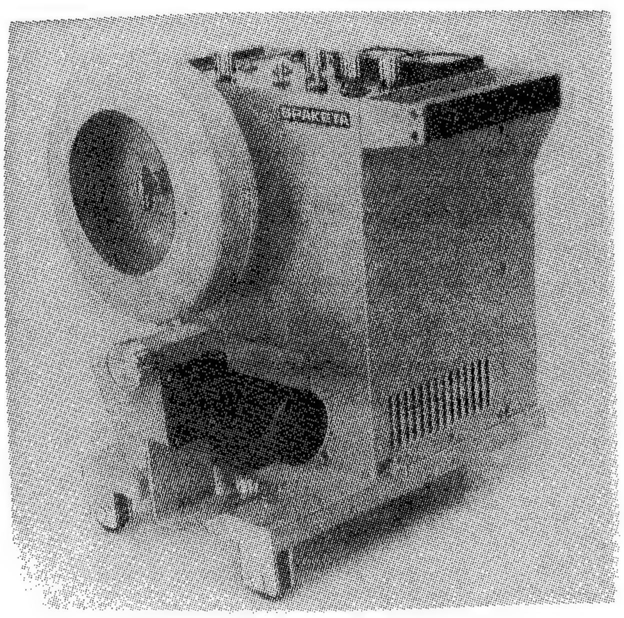
Amur Automatic Welding Machine



The Plamya Gas Cutting Machine



The Orbita Gas Cutting Machine



The Braketa Automatic Welding Machine

The plastic design of the machine components conforms to the capabilities of the factory manufacturing technology.

A test model of the item is being built.

THE ORBITA GAS CUTTING MACHINE

[Text] The machine is used to trim off tolerances and prepare edges of installation joints. The motion in space occurs along a toothed rack, similar to the Amur automatic welding machine, in various spatial positions. This feature singles out both machines from the Western analogs.

A distinguishing feature of the machine is the ability to position the cutter at either the right or left side of the axis of motion. The arrangement of the control console in parallel with the working plane also allows manipulation of the controls in any spatial position.

The composite and plastic design is similar to that of the Amur welding machine, as dictated by maximum utilization of standardized components--handles, the platform, the controls, the drive unit, and the rack mechanism.

A test model of the machine is undergoing industrial tests.

THE BRAKETA AUTOMATIC WELDING MACHINE

[Text] The machine is designed for welding brackets (footnote 1) (a bracket is a steel plate used to fasten the individual components of the ship framing) with radius of curvature greater than 100 mm. The welding is done beneath a layer of flux. The machine travels about the perimeter by a guideway, making use of a gear transmission. There are no Soviet or Western analogs.

The prototype has an unstable structure, a nonrational configuration of the mechanisms and controls, and has not been worked out in a plastic form. The more compact arrangement of the new machine reduces its outside dimensions (477 x 312 x 433 mm instead of 1200 x 200 x 590 mm). As a result, the weight and the specific metal content are lower. The stability of the machine has been enhanced by replacing the support rod with rollers.

The basic controls are grouped on a horizontal panel, instead of a vertical one (as in the prototype), which is easier to work with, since the welder does not have to squat down to check the welding regime.

Adoption is scheduled for 1987.

CSO: 1823/304
12717

OTHER METALWORKING EQUIPMENT

UDC 061.4:001.18

MACHINE TOOLS RECENTLY EXHIBITED IN MOSCOW DISCUSSED

Moscow MASHINOSTROITEL in Russian No 5, May 86 pp 44-45

[Article by G. P. Yeliseyeva: "Among the Exhibits," "At the USSR Exhibition of National Economic Achievements"]

[Text] One of the largest pavilions at the USSR Exhibition of National Economic Achievements, the Machine-Building Pavilion exhibits and advertises advances in science and industrial production, which makes it a center for exchanging ideas concerning new methods for the workplace and new ways to use advanced technologies. Many of the exhibits on display in this pavilion are familiar to readers through our publications. Today we report on more new advances by enterprises in a number of different sectors within the industry.

Bimetallic billets clad in powered high-speed steel. Cutting tools made from these billets are 1.5-2 times as durable as tools made of ordinary steel. A bimetal having the properties of a powered high-speed steel returns savings in this material of 50-70 per cent.

The process involved in producing 100-150 mm-diameter bimetal bars is based on the hot extrusion of capsules with an axial metal rod and powder and proceeds through the following steps: gas atomization of the molten high-speed steel; sifting of the powder; preparation of the capsule, which includes placing the specially designed axial rod inside it; filling and degassing the capusle; heating, and then finally extruding and finishing the bars thus produced.

Automatic assembly machines. The ASP-605 has been designed to perform final assembly of Type 605 bearings and the modifications of it, the AKS-605 to assemble the races for bearings of this type and then load the proper group of bearings into the assembly. Installation of each one of these machines will save 8,000 rubles.

PE-101 for measuring frictional torque of single-row conical roller bearings under axial load. The monitored bearings have an internal diameter of 25-110 mm, an external diameter of 52-200 mm and experience axial loads of up to 7000 N.

The design of this device increases measurement accuracy some 20 per cent, raises productivity 2-3 fold, expands the range of loads which can be applied to a bearing, permits monitoring of the entire range of bearings used in motor vehicle assembly components for frictional torque and substantially improves working conditions for the operator.

P-102 device for measuring frictional torque of a single bearing under axial, radial and combined loads over a wide range of frequencies of rotation. The gasostatic bearing in this device makes it possible to apply radial and axial loads to a bearing under examination and at the same time measure the frictional torque. The application of combined loads to a bearing approximates the actual operational conditions to which it will be subjected. Inner diameter of test bearing 10-50 mm, outer diameter 25-90 mm, axial and radial loads up to 2000 N.

The use of this device increases the accuracy of measurements of frictional torque, expands the range of loads which can be applied to a bearing and substantially increases product range. It makes it possible, moreover, to establish remaining lifetimes and replace worn bearings in a timely manner, reducing test equipment failure.

Effective methods of increasing the durability of shearing dies. These include the following: the development of proper working surfaces, insuring optimum operating conditions for the working surfaces of the machine which come into contact with the material being processed and the development of new lubricants.

Proper geometry given to the irregularities on the working surfaces of the machine, which take the form of projections and depressions, and which are oriented in the direction in which the material is moving, increases the load-carrying capacity of the surface irregularites, decreases the probability that the contact surfaces will grab and increases resistance to wear. At the ends these irregularites project at angles of 100-150°, 70-90° on the sides of the punches. The new lubricants are metallopolymer pastes. The lubricating properties of these pastes approach those of the lubricants containing molybdenum disulfide, but they are several times cheaper.

The methods outlined here will increase the durability of a die 2-4-fold and more and achieve economies of 300,000 rubles and more.

Machine for welding pipe by an arc rotating within a magnetic field. This machine can be used both on a main product fabrication line and on nonwaste lines where pipe is laid out and cut in the initial stages of production. It makes it possible to weld together hollow billets of closed cross section and varying in configuration or to weld these to billets of solid cross section. Grippers of corresponding configuration and individual magnetic fields are used for each standard-size billet.

With a capacity of 150 welds an hour, this machine can weld pipe up to 114 mm in diameter with wall thicknesses of up to 5 mm. When this machine is used in place of consumable-electrode arc welding and butt resistance welding it increases labor productivity 2-5 times, reduces electric power consumption by 20 per cent and saves on basic and secondary materials.

The UV-75 vacuum system. This device has been designed to apply aluminum, copper and silver coatings no more than 0.05 mm thick by vaporizing and then condensing these materials in a vacuum onto a moving PETP film 0.02-0.09 mm thick and (300±5) mm or (600±5) mm wide.

Mounted on base 9 (Figure 1) are the following assembly components: vacuum chamber 5, winding mechanism 12 with drive 7, vaporizer 10, exhaust unit 4, control panel 6, electrical equipment cabinets 1, 2, and 3 and cable 8.

The horizontal vacuum chamber is divided into winding and deposition chambers. The winding mechanism 12, which retracts from the vacuum chamber during loading and unloading, is provided with elements to insure proper winding and deposition (a cooling drum, stretcher, servomechanism 11, pressure roller etc.). The deposition chamber contains the vaporizer 10 with elements in the form of direct-heating boats. During the deposition process the material to be vaporized is fed to the boats in the form of a wire. The automatic exhaust unit maintains proper pressure in the vacuum chamber. The machine is controlled from control panel 6. It is designed to process at least 3 million m^2 of material a year (that is, of film 60 μm thick, 600 mm wide at a winding rate of 60 m/min).

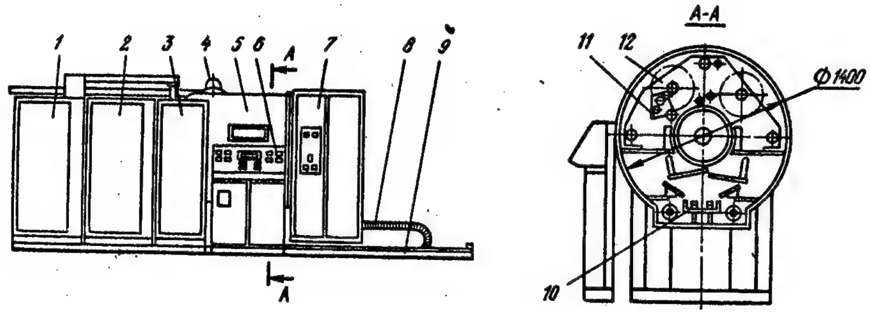


Figure 1

The vacuum systems designed by the special vacuum deposition design bureau function in this process at the level of a truly advanced technology. They help raise labor productivity and production standards through the automation of manufacturing processes, improvements in product quality and more efficient use of raw and other materials.

EDN-3 variable-capacitance transducer. This device has been designed to provide discrete and continuous monitoring of moisture levels in bulk and powdered material, raw materials or finished production on a moving line, on a conveyor belt, for example. Moisture can be monitored at levels ranging between 0 and 50 per cent.

The strip electrodes in the transducer are positioned at equal distances from one another below a plane insulating substrate, suspended at one end by a jointed suspension, the other end resting on wheels. To prevent error due to uneven filling with the material being monitored and reduce electricity consumption by the sensor and other auxiliary devices, the suspended end has a smoothly curved housing and makes it possible to regulate the height of the suspension. Rigidly attached to the outside of this housing is a switch with a movable blade, through which electrodes are connected to the measuring system. In response to the action of the flexible blade (when the material being monitored reaches a certain level), signals proportional to the moisture in the material feed to the measuring system by way of normally open contacts.

Economies from the introduction of a moisture-measuring system using this sensor, in an iron foundry which turns out 1000 tons of castings a month, for example, have reached more than 90,000 rubles a year. These are economies resulting from

the fact that fewer castings now have to be rejected because moisture levels in the molding sand do not meet the requirements of the process employed.

PND-250 continuous loader. This machine can be used in any of the country's soil and climatic zones to loosen and load organic fertilizer, organic-mineral mixes, peat and compost into high-capacity fertilizer-application machinery and other transport vehicles.

All the primary assemblies of the loader are mounted on a single frame (Figure 2), which is in turn mounted on a DT-75MV tractor equipped with a special reducing gear to maintain proper application speeds. The implement is driven by the power take-off shaft and hydraulic system of the tractor. The loader is operated by controls in the cab of the tractor.

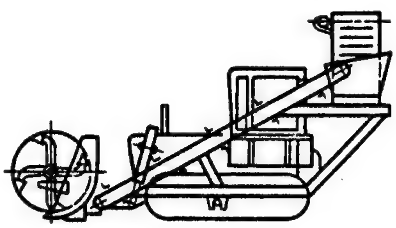


Figure 2

To load material the loader moves along the right side of a pile with the collecting implement lowered to the ground; the transport vehicle approaches from the right of the loader and advances as required to keep up with it. When it reaches the end of the pile, the loader turns around for another pass. In one hour this machine can load 200 tons of manure and 150 tons of peat to a height of 3200 mm.

Unlike existing loaders, the PND-250 can break up and mix fertilizer during the loading process, which keeps the machine from malfunctioning during the application process, as would occur if the fertilizer contained large pieces of nonfertilizer material. This machine loads fertilizer in a uniform flow, which prevents dynamic loads on the transport vehicle. The use of one of these loaders can save more than 4000 rubles.

8963
CSO: 1823/298

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 658.516.1.[621.9+681.2]

AUTOMATION VIEWED AS MEANS FOR COMPONENT STANDARDIZATION

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 2, Feb 86 pp 5-7

[Article by Candidate of Technical Sciences P. A. Rudenko, engineer P. N. Pavlenko and engineer S. N. Borovskiy]

[Text] The creation of standardized listsof parts is a complicated technical and economic task, a solution of which requires modern methods of calculation, progressive directions in development of technological preparation of production--SAPR [computer-aided design systems],ASU TPP [Plant Management Automation Systems], and the like.

By their definition, optimization of the parameters of parts and standardization of them are contradictory to each other. Whereas the optimal dimensions of parts can be established for each standard size of an assembly unit, standardization of them is generally a deviation from optimality. At the same time, standardization increases the serial nature of production of machine assemblies and parts and provides the corresponding saving. Accordingly, optimal standardization should be achieved through technical and economic methods with regard to all aspects of the problem.

Parts have been standardized at one of the machine-building enterprises through the use of computer technology. Standardization was achieved according to the following steps: determination of the area of standardization on the basis of analysis of the use of parts with regard to the prospects for development of production, construction of an optimal parametric series and construction of an optimal series of standard dimension.

Complete information about the standardization objects was assembled during completion of the first step. Groups of parts were determined and each classification group included parts of identical functional designation. The structural-technological and circuit solutions and a list of the parameters were taken into account during their classification.

The use of sector standards for the given type of products and also technical and economic calculations if needed for comparison of the production cost made it possible to select on a substantiated basis the basic design of the part. Conversion tables, which were transformed to a stringent plant standard after standardization, were constructed with regard to these data.

The task of the second step was construction of an optimal standardized parametric series on the basis of economic mathematical models of the standard dimensions of basic parts. Thus, the distance between centers, height and diameter (width) were the parameters that determine the design for parts of the lever type.

One of the main parameters, which should be common for the entire list of products of a given type, was selected as the main parameter to limit the problem. This parameter for parts of the lever type is the distance A between centers. The remaining parameters were considered during the third step of standardization. The sequence of subsequent work was as follows: ordering the standard dimension series as the main parameter A increases, determination of the dependence between the cost of the part, its manufacturing program and the main parameter and optimization of the parametric series.

The standard dimension series was arranged in the following manner:

$$A_1 < A_2 < A_3 < \ldots < A_i < A_n. \tag{1}$$

When solving the problem of substitution of one standard dimension by another, the manufacturing program of the remaining standard dimension was increased so as not to disrupt the basic principle of complete satisfaction of the needs for products of the given type. An increase of the program for manufacturing products of the given standard dimension contributes to a reduction of its cost. Therefore, it is important to know at the given step how the cost of the part will vary when the manufacturing program changes.

The problem can be formulated generally in the following manner. It is known that the cost of the standard dimension A_i is equal to C_i with some manufacturing program Π_i. One must determine to what the cost of the product of the same standard dimension A is equal with some new program Π'_i

$$C'_i = f(A_i;\ \Pi'_i). \tag{2}$$

The following function should be used, according to recommendations of VNIINmash [All-Union Scientific Research Institute for Normalization in Machine Building], for simple products

$$X_i = b_0 X_1^{b_1} X_2^{b_2} \ldots X_p^{b_p} \tag{3}$$

or for the given case

$$C'_i = b_0 A_i^{b_1} \Pi_i'^{b_2}. \tag{4}$$

Coefficients b_0, b_1 and b_2 are found by correlation analysis methods from statistical data for the year, assembled during completion of the first step of the work.

The following condition should be fulfilled upon optimization (upon thinning of the series)

$$З_i + З_{i+1} \geqslant З_{i/i+1}, \tag{5}$$

where $(З_i + З_{i+1})$ is the sum of expenditures for manufacture of the entire program (Π_i; Π_{i+1} of the i-th and (i+1)-th standard dimensions, rubles, $З_{i/i+1}$ is the total expenditures for manufacture of the new program (Π'_{i+1}) remaining in the series of the (i+1)-th standard dimension, rubles.

The indicated expenditures are determined by the formulas:

$$З_i = C_i\Pi_i\left(1+\frac{1}{t}\right); \quad З_{i+1} = C_{i+1}\Pi_{i+1}\left(1+\frac{1}{t}\right);$$
$$З_{i/i+1} = C'_{i+1}\Pi'_{i+1}\left(1+\frac{1}{t}\right), \tag{6}$$

where C_i and C_{i+1} are the production cost of manufacturing the i-th and (i+1)-th standard dimensions of parts, respectively, rubles, Π_i and Π_{i+1} are the programs for manufacture of the i-th and (i+1)-th standard dimensions of parts, respectively, units, C'_{i+1} is the production cost during manufacture of a standard dimension, which replaces the i-th standard dimension, rubles, t is the length of the depreciation period, years, Π'_{i+1} is the new program for manufacture of the (i+1)-th standard dimension, units, and

$$\Pi'_{i+1} = \Pi_i + \Pi_{i+1}. \tag{7}$$

The cost, manufacturing program and dimensions of real parts were used as the input data for calculation of expenditures. The cost of each standard dimension was calculated by formula (4), i.e., the cost of the basic lever of the (i+1)-th standard dimension was determined with the new manufacturing program.

The operating costs were not taken into account with regard to the insignificant difference of the parts to be replaced with respect to the mass and simplicity of configuration (levers, screws, pins and so on) upon comparison.

The standard dimensions of those products which must be eliminated were determined in the initial series as a result of pair comparison. The series of existing standard dimensions of products (with variable manufacturing program and cost) was again compared in the new parametric series. The comparison can be made both in the direction of an increase and of a decrease of the main parameter. The sign < varies by > in series (1) in the latter case.

If the main parameter A_i was not a term of the series of preferable numbers (GOST 6636-69), a check was made of the economic feasibility of introducing a new standard dimension A'_i (similar to the series of preferable numbers).

The list of standard dimensions with rational ratio of the basic parameters is established in the third step and the secondary optimal series was constructed if need be from some of them. Thus, after construction of the standardized series of the main parameter--the distance A between centers--upon standardization of a lever part, the height of the lever was analyzed in most cases for each value of A.

Calculations by formulas (4)-(7) are cumbersome and repetitious; therefore, they were made by using specially compiled programs on the Elektronika BZ-34 microcalculator.

Introduction of the given standardization method made it possible to create stringent standards of the enterprise for some parts of general machine-building use, to use the number of their standard dimensions and to limit the increase of the number when developing new design varieties of the products. It is possible in this regard to use the method of optimal standardization (implemented on a computer of type YeS) as a subroutine in an automated production management system.

6521
CSO: 1823/276

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

PANICHEV ON FMS, TOOL MINISTRY'S DEVELOPMENT PLANS

FMS Production, Assimilation Targeted

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 86 pp 126-127

[Article by First Deputy Minister of Machine Tool and Tool Building Industry N. Panichev under the rubric "Following Up on Our Features": "The Development and Utilization of Flexible Machine Systems"]

[Text] In 1985 PLANOVOYE KHOZYAYSTVO published the articles "Several Conditions of the Intensification of Machine-Building Production" by G. Kulagin (No 7) and "Organizational and Economic Problems in the Development of Flexible Automation" by D. Palterovich (No 12). They posed important questions in the creation, incorporation and efficient utilization of flexible production systems and emphasized the necessity of improving price formation for new metal-cutting equipment. The editors approached Minstankoprom [Ministry of Machine Tool and Tool Building Industry], the USSR Goskomtsen [USSR State Committee on Prices] and Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] with a request to address the substance of the issues touched on. The text of their answers is published below.

The article by D. Palterovich justly notes the necessity of improving the planning of the production and incorporation of GPS [flexible production systems], the careful preparation of consumers for its operation, an increase in the reliability of the constituent parts and the systems overall and the implementation of standardization measures.

The concept of the creation of GPS in the 12th Five-Year Plan has been formed at Minstankoprom, the concluding period of which is the development of integrated central systems. Taking into account the high cost of GPS, however, the insufficient experience in its operation and, furthermore, the real capabilities of industry, the creation and incorporation of central systems should also be gradual, where the first stage is operative GPSs developed on the basis of standard solutions. The planning institutes and

production associations of the sector will be specialized for the output of standardized sets of equipment and process tooling.

Minstankoprom is developing and conducting a unified technical policy in GPS creation. All requests for it by the enterprises of the machine-building ministries at the technical assignment formulation stage undergo preliminary expert analysis at the corresponding technical level at the ENIMS [Experimental Scientific Research Institute of Metal-Cutting Machine Tools] NPO [scientific production association]. After this, a conclusion is issued on the inclusion of the GPS in the nominal list--the principal planning document that determines the product range, quantity and time periods for the creation of flexible production systems--and approved by USSR Gosplan.

The dedicated comprehensive Technical Level Program prepared by Minstankoprom is directed toward raising the technical level and reliability of the metalworking machinery produced, including that built into the GPS. The Nationwide Scientific and Technical Program was formulated by GKNT [State Committee of the Council of Ministers for Science and Technology] with the participation of Minstankoprom, other machine-building ministries and the USSR Academy of Sciences for the purpose of coordinating the activity of the various ministries and departments according to specialization. Besides coordination, its basic tasks include: the development of problems in providing for the automation of production processes in machine building, raising the reliability of equipment and the quality of product output and reducing manual labor, as well as creating GPS demonstration prototypes in the machine-building sectors. Besides GPS, the program envisages the creation of highly efficient industrial robots, as well as equipment for controlling them, that are intended for use in various sectors of machine building.

Minstankoprom has developed a sectorial standard for the purpose of ensuring the uniformity of the calculations executed on the economic efficiency of GPSs, mechanical machining in their planning, the assimilation of production and incorporation and production. A technique for calculating the economic efficiency of GPSs will be issued in 1986 in conjunction with the USSR Academy of Sciences and Gosstandart [State Committee for Standards].

In 1984-86, Minstankoprom prepared and disseminated to consumers in various machine-building sectors informational reference materials reflecting the cumulative experience of GPS creation, a "Catalogue of Flexible Production System Modules for 1986-90," the album "Technical and Economic Features and Structural Configuration Solutions of Foreign GPSs for Mechanical Machining" and others.

It should be noted that some of the issues considered in the article by D. Palterovich, such as planning the amounts of GPS output and the places for its incorporation, the development of fundamental areas of automation and others, are not functions of Minstankoprom. Of course, they are topical and require careful consideration. Minstankoprom, for its part, will take every step to take the proposals of the author into account in its work and to achieve the highly efficient incorporation of GPS.

Cost of Machining Centers

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 86 p 127

[Article by USSR Goskomtsen [State Committee on Prices] Deputy Chairman A. Komin]

[Text] The USSR Goskomtsen is acquainted with the issue of wholesale prices for metal-cutting machine tools raised in the articles by G. Kulagin and D. Palterovich. G. Kulagin, in considering the cost of the "statistically average machine tool" from 1960 to 1983 and noting that it has grown from 2,500 rubles to 11,600 rubles, did not take into account structural shifts in machine building. The growth of the average wholesale price of machine tools reflects technical progress in the sector. I have in mind structural shifts in favor of the output of more progressive and efficient but also more expensive groups of equipment.

The authors of the articles direct attention to one indicator--the growth in productivity of new equipment compared to general-purpose ones. But after all, besides this, its longevity, precision, and degree of automation are increasing and other parameters are improving. Consequently, one cannot draw a conclusion on the growth of prices for machine-tool equipment just by comparing them to productivity. For example, it is inconsistent to compare machining centers with ordinary general-purpose equipment. The growth of prices in machine-tool building over the last 25 years was caused not only by an increase in their parameters, but also by the increase in the cost of raw and other materials, fuel and electricity and the raising of the deduction norms for social insurance and profits. At the same time, machine tools with numerical control remain at a relatively high price level with regard to the production of electronics and electric-drive equipment as well. The output of the element base and electronic systems is also increasing, as a result of which conditions are created for reductions in wholesale prices for metal-cutting equipment with numerical control.

As for the horizontal boring machines produced by the Leningrad SPO [Machine-Tool Building Production Association] imeni Ya. M. Sverdlov, G. Kulagin has indicated an average level (60,000 rubles) of their wholesale prices, when the horizontal boring machine tool of this association with an optical system for reading coordinates (model 2A622-1 with a telescopic spindle 110 millimeters in diameter) has an approved wholesale price in the range of 51,700 rubles. The wholesale price of the machining center (240,000 rubles) has not been approved by USSR Goskomtsen.

It was correctly noted in the article that machine tools with numerical control, machining centers and robotized complexes are utilized unsatisfactorily, and for that reason their productivity is increasing by 1.5 times versus general-purpose equipment, that is, considerably less than the estimated amount. The shift coefficient of modern machine-tool equipment should be no less than 2-2.5.

FMS Benefits, Manpower Savings

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 86 pp 127-128

[Article by GPS Chief Designer for Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] Enterprises I. Mityashin]

[Text] The first GPSs were incorporated in instrument building for the production of rotating-body type parts, flanges and planar parts. Experience has demonstrated their inadequate efficiency for a number of reasons. The main one is that the machining equipment currently produced (lathes and milling machines with numerical controls) does not meet GPS requirements. It does not have built-in robots that are able to load (unload) the machine tools from feed cassettes and automated inspection equipment, as well as for clamping blanks and collecting chips etc. Due to the low reliability of the whole equipment complex, the GPS cannot be operated on two or three shifts.

The application of flexible automation, as justly noted by D. Palterovich, is more efficient in integrated systems, that is, both in the manufacture of individual parts and in assembly production. The automation of assembly production occupies a special place in resolving topical problems in increasing the efficiency of instrument building. This is explained by the fact that the labor intensiveness of the assembly and installation processes is a determining factor and totals more than 40 percent of the total labor intensiveness in the manufacture of instruments and automation equipment.

The first step on the path of the integrated automation of assembly was its automation in the mass and large-series production of instrument-building articles. Highly automated process complexes are already operating at sector enterprises. The assimilation of the output of industrial robots made possible the development, creation and incorporation of a significant amount of special process equipment which had not only the basic processes, but the auxiliary operations automated as well, such as loading, unloading, inter-operational transport etc.

The automation of mass and large-series production made it possible to develop and begin assimilating the series output of an aggregate system of automation equipment for the mechanical assembly of instrument-building articles based on industrial robots--ASAMS. It includes, aside from industrial robots, transport systems, control apparatus and auxiliary devices. The ASAMS system not only provides for a high degree of production automation (90-95 percent), but also for its flexibility in the manufacture of similarly designed articles.

The flexible production system for the assembly of technical pressure gauges of two types with 870 versions is an example of the use of ASAMS in the integrated automation of assembly. The incorporation of a GPS for realizing a program of producing 2.5 million pressure gauges a year, including approximately 150 units of special process equipment, makes is possible to quadruple labor productivity, free up 170 employees and obtain an annual

economic saving equal to 340,000 rubles, with the recoupment of expenditures over 3 years.

At the same time, articles that are produced in small and medium lots with the frequent alteration of type and changes in production volume predominate in instrument building. The creation of GPS for small- and medium-lot product output is restrained due to the absence of assembly process equipment, by the level of automation and the capabilities for resetting the programming of the appropriate multi-functional metal-cutting machine tools with numerical control. Therefore, fundamentally new assembly equipment is being intensively developed in the sector--flexible production assembly modules (GPMS). GPMSs are rapidly reprogrammed robotized assembly units that are intended for the automated execution of a broad group of operations in mechanical assembly and installation. The transition from one type of article to another requires only changes in the programs of the control system and some types of process tooling (satellites, tools).

It can be counted on that the assimilation of a broad range of GPMS equipment, automated transportation and storage systems, auxiliary equipment and standardized automated control systems in the sector will allow the creation of a number of assembly GPSs for small- and medium-series production of instrument-building articles in the current five-year plan.

The experience accumulated at Minpribor in the creation of flexible production systems proves that the efficiency of the automation of assembly processes is 3-4 times higher than the automation of mechanical machining. If the problem of flexible production systems is conside ed overall, final conclusions on its efficiency are premature. At this stage, which can be characterized as the experimental-testing stage, GPSs are not generating a sufficient economic saving. Scientific and technical progress in instrument building, computer technology and robot equipment, however, should radically alter the situation as early as the 12th Five-Year Plan. It is necessary to bear in mind that there exists no other path for the intensive development of the technology of industrial production.

12821
CSO: 1823/307

ROBOTICS

BRIEFS

TASHKENT TRACTOR PLANT'S ROBOTIC LINE--Tashkent--The work volume can be increased with less production space by a new robotic line started up at the Tashkent Tractor Plant Association. This has taken over nearly all jobs involved in the fabrication of parts for tractor trailers, replacing more than 40 universal lathes. The new line, designed to turn out more than half a million parts per year, was built by the designers and engineers of the Scientific Production Association Tekhnolog. Chemical-thermal treatment of parts, robot technical complexes, and other ultramodern engineering and technology adopted by the association are making possible an expanded production and better product reliability. [Text] [Moscow SELSKAYA ZHIZN in Russian 30 May 86 p 7] 12717

CSO: 1823/302

PROCESS CONTROLS AND AUTOMATION ELECTRONICS

UDC 681.3:62-52

OPERATION-BY-OPERATION CONTROL OF PROCESS TECHNOLOGY WITH MICROCOMPUTER SOFTWARE

Moscow KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian No 1, Jan 86 pp 33-34

[Article by candidate of technical sciences L. N. Finyakin, engineer I. I. Dubrovskiy, and doctor of technical sciences and member of the Academy V. V. Kafarov]

[Text] Modern production systems are distinguished by a high level of automation, based on the use of diversified systems for monitoring the operating parameters and controlling the process technology. The majority of automatic monitoring and control devices function according to a rigid logic, as manifested by a permanent adjustment to a given operating condition. With operation-by-operation control of equipment by rigid logic, the necessary sequence and duration of operations in the technological process of fabrication of a particular product are maintained. When the production switches to a different product, the required changes in both the sequence and the duration of performance of the individual technological operations are usually done by manual adjustment of the governors, timers, and other equipment of the relatively complicated control systems, which involves considerable outlay of time and reduces the productivity of the technological plant. In order to cut down nonproductive losses of time, the automation layouts of production plant are being continually modernized along lines of their expanded application in monitoring and control of the individual technological processes and computer hardware to enable a more expeditious acquisition of information concerning the processes in the equipment. However, as previously, it is not possible to efficiently influence the sequence or duration of performance of the operations in the equipment, due to technical difficulties in the organization of operation-by-operation control.

Let us consider a system of operation-by-operation control of the functioning of technological equipment by using the software of a microcomputer (e.g., Elektronika D3-28) on the basis of numerical program control and program segmentation of the controlling program, written in the microcomputer instruction language. The control program consists of three program modules (Fig. 1). The first module M1 includes a set of program segments designed to implement the operation-by-operation equipment control of "on/off" type. The program segments of the first module have identical structure and consist

of two parts of computer instructions: the first formulates the control input in the "Control" bus, the second sets up the address of the equipment indicated in the segment on the "Output" bus. In the second program module M2, which is a set of program segments, the time intervals of performance of the individual technological operations by the particular equipment are enumerated. The segments of the second program module are built on a common principle: they indicate the duration of performance of the operation and the numerical marker of the clock program. The clock subprogram is represented by a set of instructions, the duration of performance of which comprises one second. The segments of the first and second program modules are labeled by numerical markers. The order and duration of performance of the operations are represented in the third program module M3 by arrangement of the numerical markers of the segments of the first and second program modules in a definite sequence.

Operation-by-operation control of technological equipment with the Elektronika D3-28 microcomputer is done as follows. The control program is started by forming a signal to set all actuating mechanisms in the initial state. If even one of these mechanisms does not execute the given instruction, the control system blocks the voltage energizing all devices included within the process layout. After setting the initial state of the system, the program moves on to performance of the process cycle in accordance with the schedule represented by the sequence of markers entered in the third module.

For the technical implementation of control of the operation of equipment, an intermediate switchboard (PKU) has been created in addition to the control program. This device, assembled from discrete semiconductor components or integrated microcircuits, consists of two logical AND type components, each of which can apply low voltage to the coils of two relays switching the power circuits of the electric motors, apparatus, and servomechanisms: seat valves, gate valves, etc. As an example, let us consider the control of operation of a pneumatic electrically-powered switch, using the PKU. The layout of the PKU with pneumatic switch is shown in Fig. 2. The signal $\overline{\text{UPR1}}$ for starting the equipment and addressing this equipment is applied to the inputs of logic gate 1. The logic gate puts out a low voltage signal, which is applied to the contacts of relay R1 of module 3, switching the electrical control circuits, while the contacts of relay R2 provide a self-blocking of relay R1, resulting in opening of the pneumatic switch 4. The signal $\overline{\text{UPR2}}$ for disconnection and addressing of the equipment is applied to the inputs of logic gate 2, which puts out a low voltage signal for disconnection of relay R2 of module 3. When relay R2 is disconnected, the self-blocking electricl circuit of the first relay is interrupted, and the pneumatic switch is closed.

Figure 3 shows a circuit for operation-by-operation control of a filtration unit. As can be seen, the intermediate switchboard is an essential component for technical implementation of the control of each mechanism of the unit. The concept of positional control of the operation of the unit is implemented by the software of the Elektronika D3-28 microcomputer, which creates the signals of instructions in the "Control" bus ($\overline{\text{UPR1}}$ or $\overline{\text{UPR2}}$) and establishes the number of the required piece of equipment in the individualized line of the "Output" bus for sampling the respective PKU.

Operation-by-operation control organized on the principles of numerical program control and program segmentation has the merit that the use of computer instructions increases the speed of response of the system and affords an optimal workload of the microcomputer's working storage. When permanently used in production with the identical process technology, the first and second control program modules, containing information on the sequence of activation and duration of operation of the equipment, may be entered into the permanent memory of the microcomputer. Reorientation of the control system for production of any other kind of product is done by changing the sequence of arrangement of numerical markers of the segments of the first two modules in the third module of the control program.

12717
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PROCESS CONTROLS AND AUTOMATION ELECTRONICS

BRIEFS

PROGRAMMABLE SUPERVISOR OF LATHE GROUPS--The creation of flexible complexes and entire industries and the teaching of machine tools to interact with each other require a kind of organizer or supervisor. A programmable instruction unit is capable of synchronizing the operation of a whole group of machinery, including a parts conveyor system. Its manufacture will be done by a plant scheduled for construction in Yerevan. The new microelectronic device, scarcely larger than a briefcase, has its own memory, a high operating speed (hundreds of thousands of logic operations per second), and the ability to change quickly from one program to another. [Text] [Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 3, Mar 86 p 2] 12717

NEW MACHINE TOOLS--Unique designs incorporated in the Portal type machining center, whose serial production has been initiated with a considerable head-start on the standard schedules by a collective of the Odessa Machine Tool Building Association, have won five medals at once at the USSR Exposition VDNKh. The product line of this enterprise is being modernized in conjunction with a retooling of the industry. A new, well lighted shop has been erected alongside the corridor. From the outside, it is in no way different from its fellows. But the shop has a special purpose. Already four machining centers have been assembled beneath its roof, and as many again will soon be added. After this, they will all be linked together by a single conveyor and materials handling system. The complex of machinery and mechanisms will be controlled by a computer center, being installed concurrently with the machine tools. The enterprise is gearing up for a qualitatively new production technology. [By V. Veprik] [Text] [Kiev PRAVDA UKRAINY in Russian 5 Jun 86 p 1] /12717

LASER-CONTROLLED LATHE--[Ryazan]--The Sasovo Machine Tool Production Association has released the first Soviet laser-equipped semiautomatic lathe with numerical control. A two-coordinate laser transformer, developed by the Institute of Automation and Electrometry of the Siberian Branch of the USSR Academy of Sciences, is built into the control system of the lathe. This enhances the precision and machining speed of the parts. Designers of the Ryazan Machine Tool Production Association and the Tyazhstankogidropress Production Association also took part in developing the assembly. [By Pravda correspondent V. Shvetsov] [Text] [Moscow PRAVDA in Russian 1 Apr 86 p 3] 12717

CSO: 1823/302

TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

ORGANIZATIONAL-TECHNICAL DESIGN OF FLEXIBLE SYSTEMS

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 5, May 86 pp 32-33

[Article by engineer A. I. Alikov and candidate of technical sciences N. I. Reshetnev]

[Text] In solving the problems of integrated automation, which leads to further and more complete freedom of human beings from direct involvement in the work processes, the necessity for a clearcut organization of production arises.

The designers of flexible manufacturing systems (GPS) must confront this problem. For its solution, the members of the UkrNIISIP and the Odessa Machine Tool Construction Association have developed an organizational-technical layout, which has become the cornerstone of the future goal-oriented interrelated design process of all components and subsystems of body part machining GPS.

The article presents the experience with the organizational layout of GPS, which can assist the enterprises and organizations in speeding the development and adoption of GPS with maximum efficiency for a given production setting.

For a far-reaching intensification of production, its organization is becoming a specific problem of technological design and the cornerstone of the design for an automated manufacturing system, the level of which predetermines the effectiveness of production as a whole and as a unity of all information and material interconnections.

In order to reveal the existing information and material process flows, the organizational-technical level of the existing enterprise is investigated. As the object of the investigation, it is convenient to select a production subdivision which, on the one hand, has a similar functional purpose (e.g., body part workshops in the case of designing GPS for machining of body parts) and, on the other, which is made up of NC lathes with sufficiently elaborate interconnections to all the services of the factory, i.e., at the level of the workshop or the individual consolidated production section.

The analysis clarifies the aspects of organization of production, labor, movement of documents and objects of labor, planning and reporting, so that the nature of the interplay between the workshop and the departments (services) of the factory can be determined rather comprehensively.

Analysis of the document circulation enables development of such system of information process flows of the GPS as is organically circumscribed within the long-established document turnover system of the factory and helps in solving the full range of GPS management problems.

The investigation also elucidates the functions of the workshops and factory services with respect to the workshop under study, and the long-established methods of planning, management and accountability. It determines the "bottlenecks", the absence of essential functional connections, and disproportionality between the capabilities of the workshops and services and the requirement for a regular production of finished products.

One of the chief types of disproportion in small series, multiple item production is the long time of engineering preparation of production. This major problem can only be solved by creating automated systems of design (SAPR) and technological preparation of production (ASTPP) on the basis of modern computer technology.

The GPS should provide a closed production cycle, for which it should structurally consist of the following divisions: management; technological preparation of production (TPP); production; acquisition of tools and machining attachments; inspection; maintenance and repairs.

A coordinated functioning of the divisions is enabled by developing interrelated systems: control of production (ASUP); operational supervision (ASODU); an automated system for technological preparation of production (ASTPP); quality inspection and control (SAK).

Depending on the specific conditions, the GPS may include a varying assortment of systems. For example, if a centralized ASTPP is present at the factory, it is ill advised to create an independent system within the GPS. The same decision can be made when developing a GPS for large series production of a limited assortment of parts (5-30 items).

In terms of organization, all the attending personnel of the GPS should be combined into a single self-financing brigade, or a kind of brigade-technology complex, which is the prerequisite for boosting the labor efficiency through increased responsibility, extensive familiarization of the workers with related disciplines, and an enlarged outlook of the work force, and which will enable the commencement of education of the factory workers of tomorrow.

A typical GPS should implement the most complete machining of parts for which an appropriate set of basic technological equipment is selected. Furthermore, the system should carry out the transport and storage (accumulation of billets, semifinished articles, finished parts, machining attachments and tools between operations), accessorizing and adjustment of tools and machining attachments,

as well as development of a full set of planning, reporting and technological documentation (including such for operations carried out by cooperation outside the GPS) and control programs for NC equipment.

The ASTPP should perform the following functions: development of a process flow chart for the entire machining of parts from the billet to the delivery of the part for assembly, taking account of all kinds of collateral operations; detailed development of operational schedules and adjustment charts for tools and machining attachments; standardization; preparation of control programs; grouping of parts and preparation of a group technology to shorten the retooling time within parts of the same group; preparation of data for the ASUP and ASODU.

Furthermore, the ASTPP may perform special functions: statistical analysis of the course of the technological process; alternative layout of technological processes for optimal control of the GPS, thereby solving the problems of long range and current production planning, consolidated and operational technology design.

The system should solve the following problems: description of the initial information in computer interactive mode; selection of a generalized technological process; selection of machining schemes for each elemental surface; formulation of an individualized process flow chart; formation of the operations; selection of auxiliary, cutting and measuring tools; calculation of the dimensional characteristics of the machining steps and calculation of the dimensional sequences between operations; calculation of the cutting regimes; selection of machining attachments and formation of accessorizing charts; standardization analysis; formation of tool selection charts; calculation of individual parameters of the billet; automatic updating of information concerning standardized technology and design elements; development of control programs for NC machines.

The fundamental principle for the functioning of the ASTPP is a multilevel typification of manufacturing procedures: from the manufacturing step to the control program element.

The ASTPP should be informationally tied into the ASUP and the ASODU of the GPS, since it is the source of information on material and labor standards for the former, and the composition of the technological processes and design technology part groups for the latter.

Reliability of the technological processes of the ASTPP is guaranteed by the following measures: working in the tools; roughing to lessen the impact and peak loads; confinement of the cutting depth to 60 percent of the length of the cutting edge of the tool with optimized feed; 40-60 percent reduction of feed at the instant of cut-in and buckling; 10-20 percent lowering of the cutting duty in a setting of reduced work force (night shifts and days off); preventive changing of tools on the basis of nominal wear.

The functions of the control system may be defined on the basis of the existing projects.

The system for product quality assurance is based on the following primary elements: 100 percent incoming inspection of billets; assurance of tool set-up accuracy outside the lathe; assurance of accuracy of assembly of machining attachments; spot check of accuracy of machining of critical surfaces by universal gages; checking the position of the billet on the machine; checking for availability of tools and tool wear; periodic certification of stability of parameters of the technological process by using test workpieces and test programs; incorporation of corrections in the control programs on the basis of the actual parameters of the cutting tools and check tests.

One of the conditions for quality and reliable operation of the GPS is the gathering up of metal shavings. The basic process technology should possess a set of properties enabling rational organization of the manufacture: foremost--high concentration of operations, universality, ample technological possibilities in machining parts of a given class; convenience of attendance, unimpeded safe access to the work zone for active observation of the course of the technological process; checking of availability of tools and tool wear, checking of the position of the billet, checking of the quality of machining; convenient drop-off and sweep-up of shavings, possibility of centralized removal of shavings, protection of the basic elements of the lathe and its accessories from the shavings; the lathe control system should be connected to a central computer for exchange of organizational information and input of new control programs into the NC from the computer memory; convenient tool replacement (preferably changing of entire holders with sets of tools); aggregate modular design for easy repair by replacing whole assemblies; possibility of accumulation of billets and automatic loading, as well as sending of the finished articles to a centralized transport and accumulation system (TsTNS).

A vital organizational element of the GPS is the ATNS, which solves two organizational-technical problems: formation of the material process flows and supervision of the movement of material resources in the production section.

Analysis of the output of the transportation facilities and the capacity of the material handling stations largely determines the successful operation of the GPS. The capacity of the material handling stations is evaluated with an allowance for an emergency reserve, guaranteeing a well-paced supply of billets to the machines. It is expedient to presume that the process flows of parts are independent, with a particular type of part coordinated with a definite machine in the context of a single start-up production lot. This is valid, since a particular control program is present in the working storage of the machine at a given instant of time, while a certain selection of tools is present in the tool magazine. Accordingly, a special procedure has been developed in the design of GPS and diagrams have been worked out for determining the capacity of a materials handling station, taking into account the average part machining time and the maximum delay for arrival of billets at the GPS.

The parameters of the transportation system can be found on the basis of the theory of queuing.

Smooth operation of all GPS subsystems and elements requires comprehensive development of the control algorithms and structure of the material and information flows.

The GPS will be effective under maximum utilization of the basic process technology, which requires it to be used during no less than three shifts. The reduced work force in the night shift is made possible by high-quality preparation during the daytime.

Much attention should be devoted to the training of the staff for a quick introduction and effective operation of the GPS.

An important element of the organizational-technological control of the GPS is its information model, which describes the composition and structure of the information flow. For an informational tie-in of all subsystems, a unitary system language has been elaborated, consisting of term vocabularies, special documentation, and an ASTPP.

In order to disseminate the experience with the organizational-technical design of GPS, procedural recommendations have been developed on the basis of a specific design and are being prepared for publication by the VNIITEMR.

12717
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TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

UDC 621:65.011.56: 65.011.72

FMS INTRODUCTION, ASSIMILATION DIFFICULTIES OUTLINED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 6, Jun 86 pp 13-14

[Article by V.A. Voloshin, engineer, under the "Economics and Organization of Production" rubric: "Some Difficulties in the Introduction of FMS"]

[Text] In accordance with the government's recent decree, all industrial ministries are planning the development and introduction of flexible manufacturing systems (FMS).

A study of the literature on the development and construction of production equipment and automated control systems used in FMS reveals that not all questions have been answered. There are already a number of standardization documents intended to eliminate the difficulties which arise in the development of FMS designs, but problems remain.

The Ministry of the Machine Tool and Tool Building Industry's work on the design, development and introduction of flexible manufacturing modules (FMM) is well underway, although little is being done to integrate these modules into the entire manufacturing system.

There is an impression that developers are faced with the task of creating an FMM design to operate in a standalone configuration without any link to the automated conveyor and warehousing system (ACWS) (which, by the way, is also the case with FMM developed by foreign manufacturers). This is reflected in the fact that current FMM for casing components have their own magazines while FMM for rotary components have cycling tables with manual blank loading and finished product removal.

Handling devices or combining devices are different in design and can differ in their height above the floor. This complicates the use of standardized tables/accessories as well as the use of robot trolleys whose design and production are being unjustifiably delayed.

The specifications of the ETR-1001 and ETR-1002 robot trolleys in the planning and development stages (developer: the Ministry of the Electrical Equipment Industry) are unsatisfactory for current requirements, but a Rotor-1 model has already been created (and shown at the USSR VNDKh [Exhibition of Achievements

of the National Economy] at the "Scientific and Technical Progress -- 1985" [NTP-85] exhibit. This is a more modern unit which does not require a light-reflecting strip or an induction loop and which simplifies the design of handling devices.

The automated warehousing systems (AWS), developed and produced by industry (Ministry of Heavy and Transport Machine Building), move containers to FMM by various conveyors and dictate definite links to the FMS due to the impossibility of changing the route followed by the containers.

The ASV systems designed by the ENIMSom are prototypes of these systems. One of the requirements placed on a robot trolley is that of on-line course changes made automatically upon commands from the FMS operator. This function is provided in the Rotor-1 via a radio channel.

A large number of organizations participate in the development of FMS projects. These organizations belong to a number of departments and, of course, departmental barriers do affect the design process.

The problems of implementing "unmanned" technology require greater attention to the interfacing of many levels of manufacturing equipment.

Let us examine some of these. There is an urgent need to design and produce standardized handling devices which can be used throughout the production line to handle casing products (components) as well as rotating components. The mounting surfaces and grippers of tables/accessories need to be standardized to permit the placement of blanks on machining center tables and to facilitate handling operations. Today the machining center has its original table/accessory. At this time automated warehousing systems cannot work with flexible conveyors (robot trolleys) due to difficulties faced by stacking cranes in precisely positioning containers (+/-0.5 mm tolerance in table/accessory positioning). This requires the presence of rail trolleys (the Talka-500 system) in automated lines for rotary component machining or trays beneath the tables/accessories, which in turn leads to a greater requirement for power, additional mechanical systems and work space. Cycling tables in rotary component FMM with manual blank insertion and finished product removal are not contemplated in an FMS working under the direct control of an automated control system in the automatic mode.

The use of the cycling table is only justified when it can be loaded (or unloaded) by the automated conveyor/warehousing system in an automatic mode. The RRTKZDF exhibit at the USSR VDNKh, based on the 1P756 machine tool, came closer to this. It is assumed that the manually loaded cycling table has become obsolete. A solution to this question could be found at the USSR VDNKh among the NTP-85 exhibitors -- an FMM segment based on the STP-220PR machine tool and others in which Elektronika-NTsTM 01 (RM-104) work directly with magazines and transport containers delivered by robot trolleys.

There is also concern about the large number of numeric control (NC) devices (designed and produced by the Ministry of Instrument Making, Automation Equipment and Control Systems) used in FMM. This is complicating the work of interfacing NC equipment with the Automated System for Production Engineering

Control without creating non-standard interfacing devices which, just as the development of non-standard production equipment, require the expenditure of tens and hundreds of thousands of rubles.

It is understood that a multi-product FMS consists of FMM produced by different enterprises using different NC devices.

Thus, in designing FMS configurations one of the enterprises selects the following machining equipment from the Ministry of the Machine Tool and Tool Building Industry family:

An Elektronika NTs-31 multipurpose 1P756F4RM chuck lathe NC FMM.
An Elektronika NTs-80-31 1P420PF30RM bar/chuck lathe NC FMM.
A 2U32 multipurpose 11B40PF4M bar/chuck NC FMM.
An Elektronika NTs-31 16B16T1RM bar/center lathe NC FMM.
A 2U32 multipurpose 11B16VF4M multipurpose bar lathe NC FMM.
A 2M-size, multipurpose 2254VM1F4M jig boring/reaming 2S42-65 NC FMM.
IR-500PM1F4M3 and IR-320PM1F4M machining centers.
A VE-155 coordinate measuring system with SM-1 computer-based numeric control.

Each of these FMM (machining centers) has its own storage unit which does not provide for connection to the automated conveyor and the NC devices do not have outputs to the upper levels of the FMS control system. In order to build an FMS with this equipment and to allow the system to work in an automatic mode under direct computer control, non-standard interfaces would have to be created to connect the production equipment with the ACWS, the NC system and the FMS automated control system. In practice this means that the basis of the FMS -- its modularity -- has disappeared. Instead of being a standard structure, each FMS created is a unique entity, even though the principle of modular design has been preserved at the subsystem level. All these problems can and must be solved on an all-union scale. Their solution at the sector level leads to excessive material outlays.

12746
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TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

FMS SYSTEMS ASSIMILATION, ROLE OF ANALYSIS DISCUSSED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 6, Jun 86 pp 35-37

[Article by V.D. Panteleyev, candidate of economic sciences, and A.S. Kirey, engineer: "The Role of Analysis in Flexible Automated Plant Control Systems"]

[Text] One of the most important developments in the intensification of general manufacturing under modern conditions is the acceleration of the process of introducing a new type of equipment and systems --one which operates without direct human intervention. Here a fourth unit (the automatic control system) is being added to the conventional three-element machine system (tools, drive units and conveyors) on an ever wider scale.

At its current stage of development the production automation process consists of the gradual integration of systems for controlling manufacturing processes and systems for on-line control of basic production within the context of Flexible Automated Plants (GAP).

Study of the theory and practice of flexible automated plant control allows one to draw the conclusion that the Flexible Automated Plant Control System is generally typical of organizational and process control systems. Its primary purpose is to control the operation of equipment within the flexible automated plant on a real-time basis and to ensure that the flexible automated plant's operation is coordinated with that of the Automated Control System for Engineering Preparation for Production, the Automated Design System and the Automated Enterprise Management System. Additionally, experience to date shows that the most important characteristic distinguishing the Flexible Automated Plant Control System from other control systems is the fact that two organic principles form its methodological foundation: on-line control when deviations from the programmed production process occur and situational control based on a previously prepared algorithm.

Frontline experience in the design and operation of Flexible Automated Plant Control System tasks has been gathered through the use of the Technologically Automated Complex Operation Simulation System (SIRTAK) in multi-item line-flow production of electronic components. An algorithm was produced with this system to allow the control of product output flow to be dependent on the fulfillment of planned product output tasking.

The computers used in the Flexible Automated Plant Control System have the following operational characteristics:

As a rule, the computer system operates on a real-time basis.

Computer load levels (the volume of calculations made and their structural characteristics) are determined in accordance with the manufacturing system being controlled.

There is a fixed set of tasks to be carried out and algorithms to be executed.

The presence of these features permits the conclusion that the potential capacity and resources of the computer system will not be fully utilized on a continuous basis in the future.

This is made possible only by designing Flexible Automated Plant Control Systems around the principle of on-line control in case of deviation.

Implementation of the principle of on-line control in case of deviation in the Flexible Automated Plant Control System is possible because the flexible automated plant's hardware includes automatic recording devices which provide information at any time on process element status and on any deviations from given parameters.

Implementation of the principle of situational control is possible in the Flexible Automated Plant Control System because the set of actions under given limitations is known in advance and reactions to these actions by individual manufacturing complex components in the flexible automated plant can be provided for in advance.

This type of approach to flexible automated plant control is needed because control decisions in the Flexible Automated Plant Control System must be made in very short time spans and the system being controlled must change its state very quickly. Therefore, the Flexible Automated Plant Control System relies exclusively on computer technology for the development of alternative decision variants for differing production situations and for the selection of a single decision (the optimum one for the specific situation) from among a set of decisions.

Implementation of these principles in the Flexible Automated Plant Control System is directly dependent on the formation of informational support. It appears that the Flexible Automated Plant Control System's database should have as its foundation:

On-line data on the device being controlled (production output, availability of manufacturing tools, status of individual production modules).

A number of reference files (libraries: order-filling priority, process variations classified by order, standard production situation parameters, control decisions for standard production situations, etc.).

On-line data on the status and loading of control system elements (usage of main memory, communication channels, external memory, etc.).

Analysis must play an important role in the Flexible Automated Plant Control System. Evidence of the specific nature of analysis function implementation in the Flexible Automated Plant Control System is seen in the fact that a set of potential target-system states is developed prior to production process startup and that, during equipment operation, control signals which alter this process are generated according to specific algorithms and criteria on the basis of operational information received.

The concept of an adaptive capability for controlling equipment groups can be implemented on the basis of analysis function development in the Flexible Automated Plant Control System. Known adaptive equipment control systems are based on automatic alteration of tooling parameters, automatic tooling retrieval (according to given criteria) and automatic coordination of geometric system element layout. Particularly well-known are those systems whose implementation involves the regulation of equipment according to threshold parameters such as deformation, feed, rate, cutting force, cutting depth, drive load, dimensional tolerance, shape distortion, surface roughness, etc.

In these systems the parameters controlled are not classified by the control requirement as unconditional (the alteration sequence is fixed and must be observed) and conditional (the alteration sequence is known but the need for changing given parameters depends on the supplementary analysis of target-system status). The absence of control actions for conditional parameters only affects the duration of component machining (the duration of equipment operation). In contrast to this group of parameters, the absence of an unconditional control action, for example a listing of minimum permissible component dimensions, in principle does not allow the expected result to be achieved.

The degree of adaptive control function implementation, as defined by the number of parameters controlled, is directly dependent on the amount of computer resources allocated to the purpose.

Under conditions in which equipment units are temporarily operating at less than full load, a characteristic of small-scale production with a constantly changing product line, the reduction of machining times on undertasked equipment by means of adaptive control systems does not result in a reduction of the overall product output cycle. In this case the use of conditional parameter adaptive control systems (such as input rate, cutting speed or drive load limit) is unsuitable because the capital outlays for the development and operation of adaptive control devices for individual machines is higher than the equivalent expenditures for equipment with simpler forms of program control.

If each equipment unit is individually controlled, the increase in the degree of adaptive control system development involves an increase in computer hardware parameters and a corresponding increase in the cost of the control system.

The implementation of economic analysis functions in the Flexible Automated Plant Control System, using the computer network as their base, allows an increase in adaptive control efficiency. This is achieved because in the known control systems, including methods in which equipment is controlled by limiting parameters, the last of the conditional parameters is executed only when a specific unit is identified as a bottleneck in the production system, on the basis of given criteria from data on the production schedule and the course of its fulfillment. The operation of this unit defines and limits the equipment tasking values of the production system as a whole. Otherwise the equipment is operated with simpler, non-adaptive means of program control and computer equipment is reallocated between machines which are implementing various means of program control.

In specific terms, the analysis function's implementation in the Flexible Automated Plant Control System extends to the fact that most of the analytical work is performed by control system developers before the production process starts. A comparative analysis of various production system parameters which could arise during component machining is carried out as early as the control algorithm preparation phase. The analytical information thus obtained, based on the possibilities for producing the same components through different operational processes considering the maximum limit of equipment downtime and the establishment of operation limiting conditions in various production situations, is used to prepare control solutions which are optimal in terms of the criteria provided. These control solutions are stored in the appropriate Flexible Automated Plant Control System data library and will subsequently be implemented by means of special programs.

From the point of view of control technology, each control solution has its own list of commands issued from the information distribution unit to the control section unit:

Production preparation: Work priorities are given, component lot sizes are calculated and the data required to start and stop component lot machining are input.

Equipment status control: The equipment is adjusted for component machining according to the method given.

Tool and accessory control: Data is formulated on tool and accessory requirements.

Conveyor control: Information is processed on the movement of blanks, components, tools and accessories.

Next the analytical information is used during the manufacturing process implementation stage when deviations from given production conditions arise (changes in component machining process parameters or in planned output

tasking in terms of the number and type of products, equipment failures, etc.). Under these conditions, operational information containing the specific parameters which make up the manufacturing process is used to describe the situation according to an established scheme. Subsequently a previously prepared algorithm is used to compare the parameters of the actual situation with situations described in the automated control system's database. This comparison is intended to be used for selecting the known situation which deviates least from the actual one. After the required situation is located there is an automatic shift from one type of component machining to another and the operating modes of the individual machines are changed as required.

The inclusion of an analysis function in the Flexible Automated Plant Control System allows known means of simple and adaptive control over individual machines to be combined within the framework of a new method -- adaptive control of equipment groups.

This method of program control over equipment groups is innovative in that traditional means of simple and adaptive equipment control are combined and implemented in a single control circuit. This produces a qualitatively new result -- a means of temporarily increasing the degree of adaptive control over component machining at individual equipment units. Here, the hardware parameters of computer equipment in the control system can be limited to the minimum needed to carry out simple program control or the simplest adaptive control programs. In this case, the degree to which adaptive control functions are implemented depends on the resources available in the computer network used in the Flexible Automated Plant Control System rather than on the technical parameters of computer equipment for the individual equipment units.

The increase in control efficiency obtained by this new approach comes from the fact that each unit in a specific group is provided with the capability of automatic selection and implementation of simple and adaptive control for the machining of the same component. Depending on the control method in use at the individual machine level, any modification changes the component machining time as well as the amount of computer resources involved. An analysis of individual equipment load levels is carried out during the production process and the degree to which any deviations arising during this process will affect the attainment of planned goals is calculated. Here, any individual equipment unit which is a bottleneck at a given moment during the execution of the production program is allocated control system computer resources from other equipment units by means of procedures executed automatically in the computer network.

Machining time at the specific equipment unit level is reduced by this increase in the use of adaptive control. The additional resources thus required are mobilized and redistributed by implementing simpler programs on other equipment units. This increases materials machining time on these units, a condition that can be tolerated in small-scale production since part of the equipment is periodically operating at less than a full load due to the constant change in the product line being produced. In all, the productivity of the equipment group is increased.

We must bear in mind that the flexible automated plant is a highly productive and very expensive system with a profound effect on association and enterprise fund expenditures. Flexible automated plant equipment makes production extremely expensive when compared to NC machine tools, therefore, the task of achieving the maximum extent and level of flexible automated plant equipment loading is especially critical.

This most important task can only be solved successfully by selecting an effective means of flexible automated plant control. Experience has shown that conventional control methods and Automated Production Control System algorithms based on these methods cannot provide optimum control over these complex manufacturing systems.

In our opinion, Flexible Automated Plant Control System algorithms must be built around a base of on-line deviational control and situational control methods combined in a framework of equipment unit group adaptive control. Failure to consider control methodology questions during the process of designing a Flexible Automated Plant Control System and, to a greater degree, an orientation toward exclusive reliance on the use of design decisions previously used in Automated Production Control Systems can lead to design decisions at the initial system design stage that will reduce the economic effect that associations and enterprises must attain from the advantages inherent in the technology of flexible retoolable equipment.

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TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

BRIEFS

MINNEFTEGAZSTROY AUTOMATES FACILITIES --The recent inauguration of a new automated data processing complex at the computer center of the ministry is helping to accelerate the development of another five automated management systems. These will cover the working activities of all process flow lines, trusts, enterprises, associations, central boards, and the sector as a whole. Moreover, specialized systems are being developed: ASU finance, ASU procurement, ASU labor organization, ASU repairs, and others. All told, the capability of the computer complexes of the Minneftegazstroy will be doubled in the five year period. By 1991, there will be seven information and computer centers functioning in the sector, 50 computer management complexes, hundreds of personal computers and 2300 automated information processing stations. All the costs of creating such well developed computer network will be recovered in this same five year period. [Excerpts] [Moscow NTR: PROBLEMY I RESHENIYA in Russian No 10, May-Jun 86 p 4] 12717

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